THE MARINE REVIEW

VoL. XXXIV. CLEVELAND, DECEMBER 20, 1906. No. 25

The Harbor of San Diego, California.

By Clarence E. Edwords.

Harbors that are safe, are not so plentiful on the Pacific coast of the United States as on the Atlantic side, but the lack of quantity is made up by the excellent quality of these havens for sea-faring men. The first port of call for all vessels coming toward the United States from the south, on the Pacific ocean is San Diego, which has a harbor that ranks with the best in the world. It is the southernmost of all the harbors of California, and lies completely land-locked, affording full protection to shipping from any storm which may blow. No vessel has ever dragged her anchor, and no marine disaster has ever occurred on account of a storm in San Diego harbor.

BAY AND CITY OF SAN DIEGO FROM POINT LOMA.

With an area of about twenty-two square miles the harbor lies in the form of a crescent, thirteen miles long and varying from half a mile to two miles in width. So deep is the entrance that "white water" is never seen there, and there is very little perceptible swell. The bar at lowest tide marks 31.5 ft., while at high tide it reaches 35.5 ft. There are no hidden reef, sunken rocks or treacherous currents to guard against, and the entrance is straight and easy of access. So smooth and placid are the waters that there is never any chafing of vessels lying alongside the docks, and so calm is the atmosphere that only once or twice a year do the winds reach a velocity of twenty-five miles an hour. The strong northwesterly winds which prevail along the coast are fended off by Loma peninsula which forms the northwestern shore of the bay.

It is a matter worthy of note that in the past thirty-four years the wind in San Diego harbor has reached a velocity of 40 miles an hour, and that was in February, 1878. The following table compiled by Ford A. Carpenter, local forecaster, United States weather bureau service, gives the highest wind velocity, direction and year for each years:

Month.	Velocity.	Direction.	Year.
January	37	SE	1873
February	40	#	1878
March	37	#	1876
April	39	#	1877
May	33	S	1905
June	24	SW	1886
July	30	NW	1881
August	25	SW	1900
September	28	NW	1881
October	32	NW	1877
November	33	W	1905
December	36	NW	1887

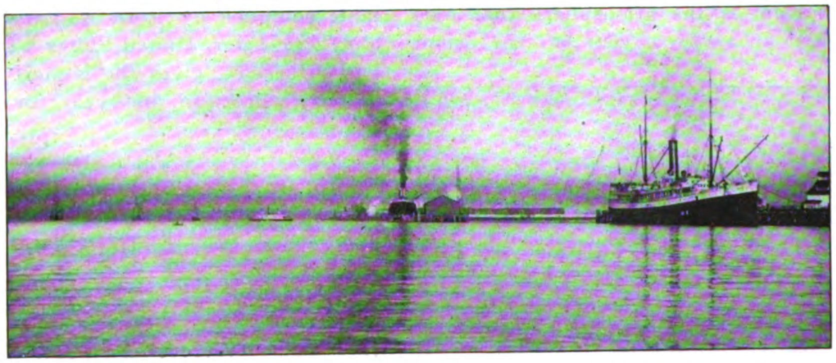
#Direction missing

WHITE SQUADRON IN SAN DIEGO HARBOR. FLAGSHIP CHICAGO, MARBLEHEAD, PRINCETON, PERRY, PAUL JONES, BOSTON AND FRENCH CRUISER PROTET.

The average channel depth of 122 of the principal ports of the world is 30.06 ft. The channel depth of the harbor of San Diego is 35.5 ft., while

the depth at the quays is 51.9 ft. The bay has about ten miles of double frontage available for wharf purposes, and following the plans of the state board of harbor commissioners it is possible to construct 125 linear miles of wharf frontage, having a depth of 30 ft. at low water. Taking the average length of vessels coming to the harbor at 325 ft. it would be possible to dock 2,000 vessels at the same time. The present depth of the bay varies from 80 ft. opposite the wharves at San Diego to 30 ft., ten miles up the bay.

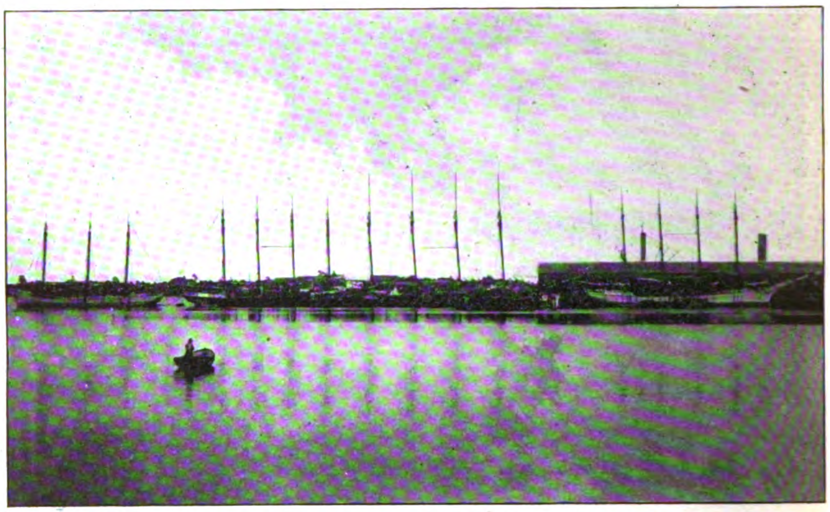
The government is spending millions of dollars to deepen the entrance of New York harbor to 40 ft. This can be accomplished at San Diego with the expenditure of $100,000. The shoal part of the bar is so narrow that a channel about three-fourths of a mile long would reach from 40-ft. water on the bay side to 40-ft. water on the ocean side. What this means will better be understood when it is remembered that the Ambrose channel now being dredged in New York harbor will be more than seven miles long.



UNLOADING AT THE DOCK. SANTA ROSA AT PACIFIC COAST STEAMSHIP WHARF. THE AMERICAN-HAWAIIAN LINER ARIZONIAN UNLOADING PART OF HER CARGO.

The largest vessels now on the Pacific ocean may enter San Diego harbor without danger, at almost any time of the day or night, and it is the only Pacific harbor in the United States south of San Francisco in which deep-sea vessels may enter and lie at wharves.

This harbor is necessarily destined to become the great route for Oriental, South American and Australian trade, as it is nearer to Galveston, New Orleans, St. Louis, Kansas City, Chicago and New York than any other Pacific coast American port. This distance may be considerably lessened by building railroads making direct connection with Kansas City or St. Louis. It is possible to save by a new, direct line to St. Louis 500 miles over any existing route. If a road were built directly east from San Diego to connect with the Southern Pacific railroad it would save more than 500 miles to Galveston and New Orleans. That these railroads will be built is certain, and even now construction is going on along some of the routes.



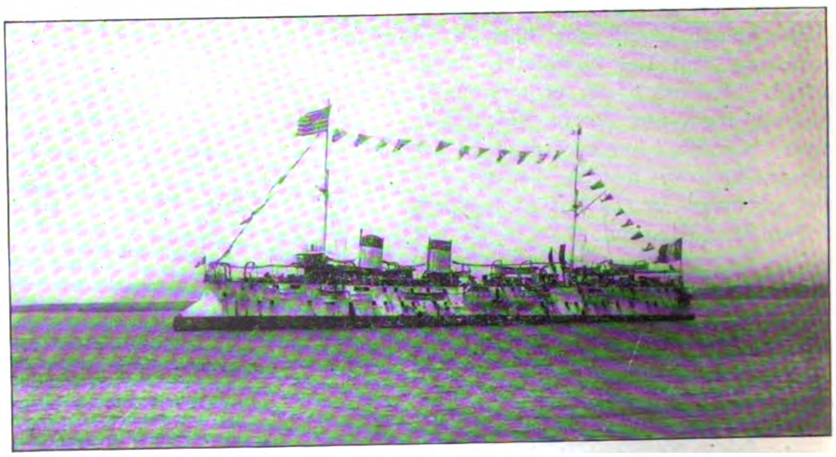
LUMBER SCHOONERS AND ONE OF THE AMERICAN-HAWAIIAN LINERS UNLOADING AT THE ORIENTAL DOCK, SAN DIEGO BAY.

Commerce advances along the lines of least resistance, and with the completion of the Panama canal San Diego is bound to be the main port of call for vessels going to the Orient, the Hawaiian islands and to Australia. From Panama to Yokohama this port is but 116 miles off the shortest route. As between San Diego and Honolulu, on the route from Panama to Yokohama the distance is more than 400 miles in favor of San Diego.

What has been done in the way of commerce in this harbor during the past four years may be learned from the following table:

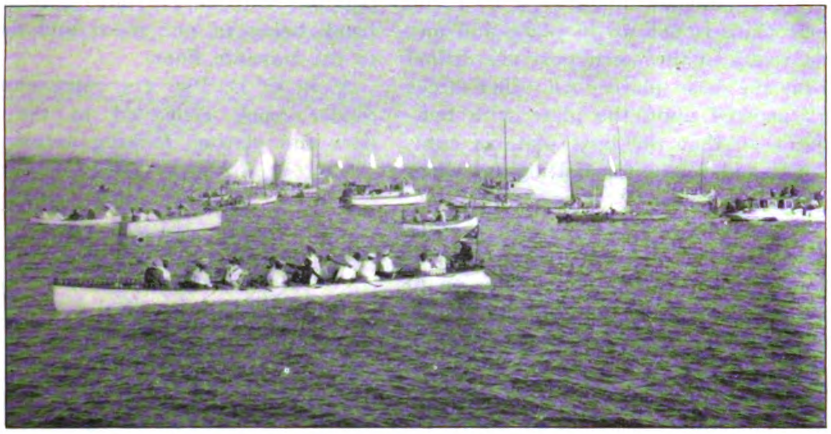
Year.	Imports.	Exports.
1903	$493,572	$314,236
1904	398,067	163,359
1905	387,038	415,639
To Sept. L 1906	332,174	251,035

The contour of the land surrounding San Diego bay is such as to make it an ideal haven. Dana, in his "Two years before the mast," often mentions the happiness and satisfaction of the crews of the various ships on



FRENCH PROTECTED CRUISER CANATE IN SAN DIEGO BAY.

which he sailed, whenever their prows were turned toward San Diego. They knew that when they reached this bay there would be rest and peace in its quiet waters. Point Loma, the landmark of the entrance, is described by Dana as "a well-wooded headland." This same description was given by a Spanish captain who visited the bay



GIRLS' ROWING CLUB, SAN DIEGO BOAT CLUB AND SAN DIEGO YACHT CLUB. THERE ARE NINE ROWING CLUBS AMONG THE YOUNG LADIES OF SAN DIEGO.

in 1602. At present this description will not apply, for the natural forests covering the headland have disappeared, but the promontory, 400 ft. high and six miles long, still stands as a sentinel and a guide for the sailor. This magnificent headland stands between the bay and all storms, and the fortifications at the foot are such as would keep an enemy's fleet at bay. Fort Rosecrans, at the mouth of the harbor, is located on the water's edge, and in addition to a number of rapid-fire guns is equipped with four large calibre disappearing guns which alone would be ample defense. The government has recognized the strategic importance of this bay and is preparing to build other fortifications.

The quarantine station is fully equipped with the most modern appliances and conveniences, and has ample and well-arranged detention quarters. Appropriations have already been made for the establishment of a naval coaling station, and it will soon be in course of construction. With a holding ground of deep, heavy, tough mud and a depth of water sufficient to float the largest vessels that traverse the sea, with room enough for the entire navy of the United States and all its merchant marine to swing at anchor at the same time, this bay is destined to play an important part in the future naval operations of the Pacific.

The present population of San Diego is 35,000. This is double what it was fifteen years ago. This population has increased through the natural advantages of San Diego, against the handicap of insufficient rail facilities. That the increase would be wonderfully greater were there direct rail lines from San Diego east, goes without saying. The harbor is well known all over the world among shipping men, and its natural position as the entrepot to California, and the United States, for that matter, to all vessels coming from the western coast of Mexico, Central America and South America, would make it one of the busiest bays in the country were the land facilities equal to those by sea.

The total tonnage of the port of San Diego for the eight months ending Aug. 31, 1906 was 29,001, and of this 27,532 was on foreign trade. The steamships of the largest lines of the Pacific come to this port, both to and from eastern ports and Europe. The Cosmos line and the American-Hawaiian lines both operate here, and in addition to these the Pacific Mail Steamship Co. makes San Diego a port of call for all of its Panama vessels. There recently entered the harbor a new kind of craft—a gigantic log raft, 600 ft. long, containing 4,000,000 ft. of lumber, which was towed from the Columbia river up on the northern edge of Oregon, and brought here to be cut up. This experiment being successful there will now come other rafts of a similar nature to this port. It is worthy of mention that outside of San Francisco this is the only port on the Pacific side of the United States where a log raft of large dimensions can be safely towed into the harbor.

It is of interest to know what others have thought of San Diego harbor. In the report of the United States engineers, issued at San Francisco, Nov. 8, 1896, page 213, is the following statement which seems conclusive as to the idea in the minds of those men:

"The harbor of San Diego is capacious of shelter and depth for any amount of commerce that may be imagined in the future."

The late Collis P. Huntington, the pioneer of the great railroad builders of the United States, and a man whose foresight in matters of commerce had become a by-word in all the marts of the world, said, when looking over the situation at San Diego:

CHULA VISTA YACHT CLUB MAKING A RUN. THIS IS ONE OF THE THREE CLUBS ON THE BAY, THE CORINTHIAN AND THE SAN DIEGO BEING THE TWO LEADING CLUBS.

"A trans-continental railroad from San Diego to Galveston will be a commercial necessity as soon as the Nicaraugua canal shall be built." (The Panama canal takes its place.)

The late Senator Frye, of Maine, whose ability and knowledge in all

matters pertaining to merchant marine have never been questioned, examined San Diego harbor, and his verdict was:

"The harbor of San Diego is one of the best I ever saw."

LAKE SHIP YARD METHODS OF STEEL SHIP CONSTRUCTION.

BY ROBERT CURR.

SHELL PLATING AFT.

Fig. 110 shows the expanded shell plating aft from the keel to the bulwarks.

Keel plate, No. 21, is fitted in two pieces the butt coming where the

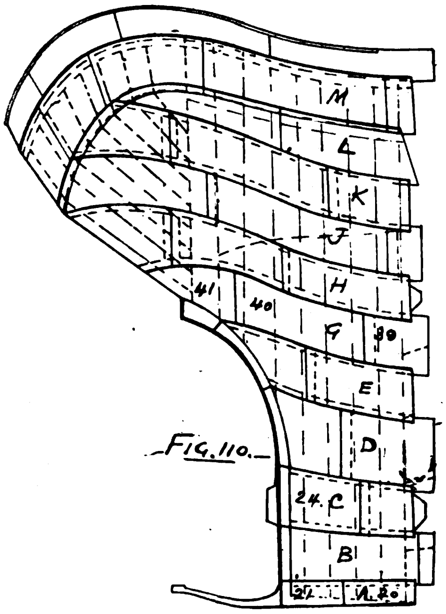


Fig. 110.

stern post begins to taper. These plates are templated from the ship when all the other plates are in place.

A, No. 20, the second last keel plate connects onto the stern post and is made in one-piece box shape as shown by Fig. III.

Fig. III shows the keel plates 20 and 21 and the B strake and frames and floor plates cut off in line with the sight edge of keel plate. The stem post inway of the keel with shoe part cut off is also seen on Fig. III.

Molds are made from the frames inway of keel plate, No. 20 and to get the proper width of the plate before setting same to shape the molds are rolled on the plate at the frame lines which determines the shape of same. After A, No. 20, is bent to shape the holes for the frames, keel liner, stern post straps and seams are laid off and drilled without any reference to the ship whatever. The frame liners and straps are also marked and punched with the same molds used for marking the plate with. The whole keel is laid off with molds with the exception of the foremost and aftermost plates, in this case No. 1 and 21. B strake on the stern post is treated similarly to a stem plate and is laid off from stem to stern post with molds. C the boss plate shown by Fig. 112 is made to shape and marked from the ship. The bossed frames are not punched for rivets until the boss plate is put up in place and any tap rivets in the stern post are drilled from the boss plate. All other holes are marked upon the plate with templates so that the boss plate is completed and ready for bolting up when erected in place.

D strake is treated the same as stem plates and is laid out from stem to stern post. E strake connecting on to the stern post is set to shape and marked from the ship with template wood.

G, No. 40 and 41, are marked from the ship, No. 41 is made as shown by Fig. 113 and marked from the ship with template wood. This oxter plate is very complicated but after it is made to the shape of the ship the frame lines and edge of the stern post are obtained from the solid set made for getting the true form of the plate from the ship. The gauge marks obtained in this way removes the complications likely to occur by any other means. Fig. 113 shows part of three

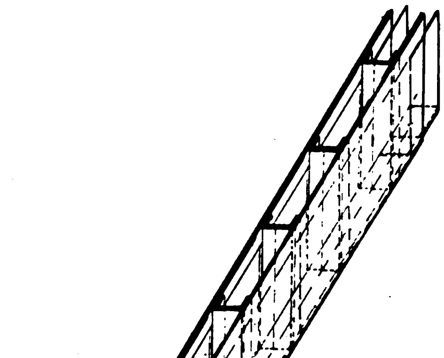


Fig. III

frames, transom, upper parts of stern frame, oxter plate and rudder trunk.

The two after plates on H strake, after plate on J, three after plates on K, two on L and one plate next the stern plating on M are marked with templates from the ship.

Molds are erected on the ship and faired up for the bulwark plating also.

The rudder trunk A, Fig. 113, is laid out, finished and riveted to the stern post before the post is erected in place.

Fig. 114 shows the method of laying out a rudder trunk, the rudder trunk being in one piece and flanged to the transom floor.

A, B, C, D, Fig. 114, represents the rudder trunk connected to the stern post and plating, looking across ship.

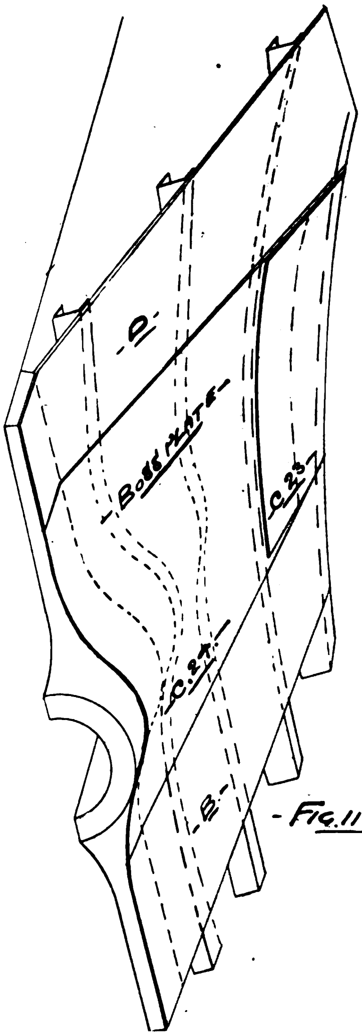


Fig. 112.

This trunk is parallel and is expanding, same is treated as a beveled pipe.

On the line AB with 3 as center a half circle is described A, 1, 2, 3, 4, 5. This half circle is divided up into five equal parts and represents the half of the rudder trunk. The points 1, 2, 3, 4 and 5 are drawn in parallel to AC intersecting the lines AB and CD at 1, 2, 3, 4 and 5.

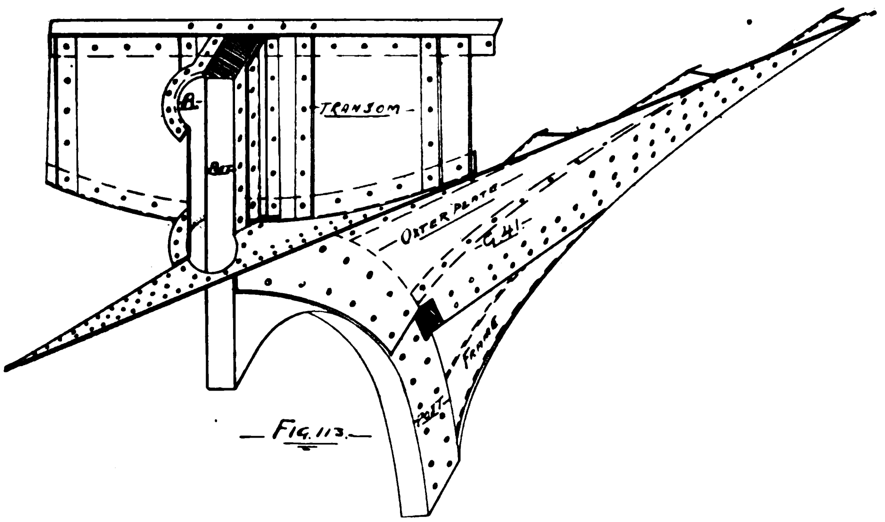
The line AB being square to the stern post this line is extended over to ELG being made in length equal to the circumference of the rudder

trunk including the flanges to the transom frame.

LF is put in at right angles to ELG representing the after end of the trunk AC.

Around the half circle A, 1, 2, 3, 4 and 5, a batten is bent and the points of intersection 1, 2, 3, 4 and 5 marked upon it from A.

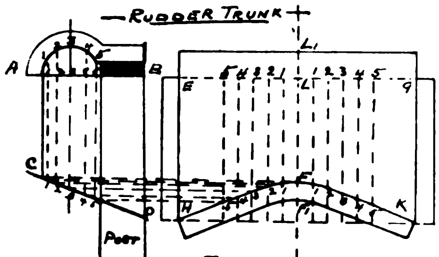
On the line ELG this batten is applied holding the point A to L, which gives the lines 1, 2, 3, 4 and 5, which



—Fig. 113.—

are drawn in parallel to LF and at right angles to ELK. The line 5 represents the stern post and ends the circular part of the rudder trunk.

The lines 1, 2, 3, 4 and 5, intersecting CD are transferred over to the expanded lines parallel to ELG as shown by dotted lines running from CD to 1, 2, 3, 4 and 5, and a batten passed through these points will give the desired cut of rudder trunk from the stern post to the center of the



—Fig. 114—

trunk and by transferring these points to the other side the whole trunk will be completed from 5 to 5 as shown on line HFK.

The lines EH and GK represent the edge of the stern post as shown by BD.

GK 55 and EH 55 are obtained by measuring the width of the stern post and adding same to the lines 5-5, which determines the width of the rudder trunk on the stern post.

The bottom of the trunk on the stern post is obtained by squaring across the point D which gives the point H and a straight line is drawn from 5 to H and 5 to K. The width of the top and bottom flanges are measured parallel to the lines ELG for the top and HFK for the bottom. LL_1 shows the width of the top flange and FF_1 the bottom flange. The projecting parts beyond EH and GK represents the flanges for the connection to the transom frame. After the plate is sheared to the shape as shown by the expanded lines the transom floor flanges are turned, then the part for the stern post 55 GK and 55 EH are set to suit the curve as shown from 5 to B after which the plate is rolled to the shape of circle whatever diameter the trunk is made to. After the trunk is rolled to the circular shape the top and bottom flanges are turned at the forge. If the stern post is drilled the rivet holes are punched in the trunk before it is bent.

SALVING THE CONEMAUGH'S CARGO.

Salvage jobs have been numerous during the past season and many difficult operations have been performed, the salving of the Anchor liner Conemaugh's deck load being one of them. This work was conducted along new lines and the fact that it was so successful has made the officials of the Great Lakes Towing Co. well satisfied, since the tug Brockway and lighter Newman did the work.

The tug and lighter were put on the job at 3 p. m. Thanksgiving day, with Capt. Sam Leonard, master of property, and Chas. Dimmers, master mechanic, in supervision. The Conemaugh went on the north side of Point au Pelee, back of the old Dummy, her stern being in ten feet and her fan tail being in about 18 ft. of water. She had a ninefoot list to port and her after gangway was under water.

It only took 22 hours, actual working time, to get the deck load, but heavy weather of the genuine Lake Erie variety made it necessary to remain on the scene six days to get in those 22 hours. The wind came from all quarters and Capt. Leonard admits the tug and lighter were all around Pelee island in looking for shelter. Speaking of shelter, he says there is no anchorage on the east side of Pelee.

The Newman with specially constructed platforms which were attached to the derricks hoisted out of the Conemaugh's between-decks 799 cases of dry goods, 1,000 packages of canned goods and 130 bags of oyster shells. The dry goods cases weighed about 700 pounds each. In taking it out, it was necessary to load it on the platforms in an uphill position and to take out the boat's davits to get the freight over her arches.

According to Capt. Samuel Leonard, master of property for the Great Lakes Towing Co., the wrecked package freighter Conemaugh, which was bought from the underwriters by Capt. James Reid, of Sarnia, is in good shape and can be rescued.

MARINE PATENTS.

Copies of these patents can be obtained by sending ten cents in stamps to Siggers & Siggers, patent lawyers, suite 11, National Union Ins. building, Washington, D. C.

837,288 Steering device for ships. John Dieckmann, Milwaukee, Wis., assignor of one-third to August Borth, Milwaukee, Wis.

837,551 Method of sea sounding. Albert F. Eells, Boston, Mass.

837,568. Vessel propelling mechanism. Martin B. Hunter, Kansas City, Mo.

837,973. Water-Cycle. Allie L. Standard, Tuscola, Tex.

838,098. Propeller for vehicles that travel in a fluid. Andre Gamblin, Paris, France.

838,313. Propeller. Jose Fola, Valencia, Spain.

A private inspection of the Momus, the new 10,000 ton steamer of the Southern Pacific Co., took place on Dec. 10 at pier 25 N.R., New York. There was a large attendance of visitors in spite of the inclemency of the weather, everyone being highly pleased with the splendid passenger accommodation and fittings of the palatial vessel. The Momus is 440 ft. in length, 53 ft. beam and 37 ft. deep, with a speed of 16 knots.

Capt. Wm. P. Potter on duty in Washington as assistant chief of the bureau of navigation, has been selected to command the battleship Vermont.

THE MARINE REVIEW

DEVOTED TO EVERYTHING AND EVERY INTEREST CONNECTED OR ASSOCIATED WITH MARINE MATTERS ON THE FACE OF THE EARTH.

Published every Thursday by

The Penton Publishing Co.

CLEVELAND.

BOSTON NEW YORK
DULUTH PHILADELPHIA
CHICAGO PITTSBURG
CINCINNATI

Correspondence on Marine Engineering, Ship Building and Shipping Subjects Solicited.

Subscription, $3.00 per annum. To Foreign Countries, $4.50.
Subscribers can have addresses changed at will.

Change of advertising copy must reach this office on Thursday preceding date of publication.

The Cleveland News Co. will supply the trade with the MARINE REVIEW through the regular channels of the American News Co.

European Agents, The International News Company, Breams Building, Chancery Lane, London, E. C. England.

Entered at the Post Office at Cleveland, Ohio, as Second Class Matter.

December 20, 1906.

THE SHIPPING BILL.

President Roosevelt will shortly after the holidays send a special message to congress urging the passage of an adequate shipping bill, thus making it known beyond question that the administration is in favor of the passage of such a measure and removing any impression of indifference that might have been conveyed in his regular message. President Roosevelt was really mightily impressed by Secretary Root's report of his observations in South America. He is determined to relieve a situation that is embarrassing to every American manufacturer. There is practically no question but that a shipping bill will be passed at the present session of congress. It should be a measure sufficiently capacious to relieve the ills under which American shipping is laboring. There is no measure better calculated to do this than the bill drafted by the merchant marine commission and which has already passed the senate. President Roosevelt would do well if, in his message, he gave this bill an endorsement which cannot be misconstrued or misunderstood. It is an absurdity that a nation as great as the United States should absolutely depend upon foreign countries for the transportation of its own products. Opponents of aid to shipping are fond of quoting Adam Smith, but even Adam Smith believed that a nation had a right to the carriage of one-half of its over-sea products. The United States carries only nine per cent of its foreign trade in its own vessels. It is justly entitled to 41 per cent more. Those who are opposing the shipping subsidies the hardest would be the first to cry if the protective duty were abolished on manufactured products from abroad. Yet it is this very system of protection that has made it impossible to build a ship in the United States as cheaply as it can be constructed abroad and made it equally impossible to operate it as cheaply after it is constructed. Secretary Root in his speech before the trans-Mississippi commercial congress in Kansas City last month exhibited a great deal of courage when he classified the disadvantages under which American shipping is being carried on as artificial and directly imposed by our own government. The tariff is certainly an artificial contrivance. It is a creature of legislation. If by this artificial contrivance it has been proved impossible to profitably operate ships, the condition should be courageously met by the extension of artificial aid. All that shipping needs is protection, the thing that every manufactured product in this country needs if it is to be rid of the competition of similar products made in other countries. There should be no beating about the bush. What shipping needs is direct assistance to meet an artificial condition imposed upon it by an American congress.

It is very odd indeed that the shipping question should come to be regarded as a party measure. It is not a party measure at all, but a straightforward bit of national business. Protection, however, having come to be regarded as the policy of the republican party, any effort to extend this policy seems to be taken as the natural duty of that party. It is unfortunate therefore that shipping, which in a larger sense means the manning of our naval vessels, the maintenance of our naval reserve, the preservation of our sea spirit, and the carrying forward of our commerce, should be regarded in a political light; but shipping has got into this angle quite naturally and it has become a so-called party measure.

The recent elections should serve as a great stimulus to the republican party in considering the shipping bill. While the new members elected will not have an opportunity to vote upon the measure at the present session of congress, owing to our general system of government wherein a man does not take his seat until one year after he is elected; yet they must serve greatly as offering sympathetic support. The elections certainly were an endorsement of President Roosevelt and President Roosevelt is in favor of the passage of an adequate shipping bill.

A BIT OF EVIDENCE.

In his testimony before the committee on merchant marine and fisheries, Mr. E. S. Cramp submitted figures to show the wide diversion between bids in Britain and the United States for the construction of a tank steamer about 500 ft. long for the Standard Oil Co. The lowest European bidder was Harland & Wolff at $613,500; the lowest American bidder was the New York Ship Building Co. at $1,024,800. The highest foreign bidder was Bluhm & Voss at $852,150; the highest American bidder was the Fore River Ship Building Co. at $1,260,000. The great excess of the American bids is due to labor—a further reason why American shipping should be protected when it goes abroad.

ORE SHIPMENTS.

Figures compiled of the ore trade of the great lakes shows an increased movement of 4,056,685 tons over that of last year, the total being 37,513,589 tons, as against 33,476,904 tons last year. During December this year 450,588 tons were shipped, an increase of 135,528 tons over December of last year, when 405,060 tons were shipped. The movement, therefore, has reached the maximum prediction made early in the year, when it was stated that 38,000,000 tons would be sent forward by the mines. There is to be added yet to this movement, the all-rail movement not yet compiled. The all-rail movement last year was 876,552 tons. An equivalent all-rail movement, which is to be expected, will bring the total shipments of the present year to 38,390,000 tons.

This great movement has been accomplished with surprising ease, notwithstanding obstacles. It has been readily handled not only by ships but by docks as well, and until the annual fall shortage in car supply occurred, there was little congestion throughout the season. The year on the lakes has been free from storms of great violence, but foggy weather has been frequent, and during December ice seriously delayed the vessels in the rivers. The total shipments of the Lake Superior mines to date has been 337,563,344 tons, of which more than one-half is the movement of the past six years. Following are the shipments by ports for the month of December and for the full season, with corresponding data for similar periods last year:

Port and Dock	Dec. 1905	Dec. 1906	Season, 1905	Season, 1906
Escanaba	131,553	134,778	5,307,938	5,851,059
Marquette	52,578	47,814	2,977,828	2,791,033
Ashland	25,224	51,515	3,485,341	3,388,106
Superior	75,151	103,679	5,118,385	6,083,057
Duluth	39,853	122,043	8,807,559	11,220,218
Two Harbors	80,701	77,729	7,779,850	8,180,125
	405,060	540,588	33,476,904	37,513,589
1906 Increase		135,528		4,036,685

AROUND THE GREAT LAKES.

The Buffalo Ship Chandlery Co. are issuing a very attractive calendar for 1907.

The annual ball of the Detroit lodge, Ship Masters' Association, will take place in Masonic Temple, Jan. 10.

The new passenger steamer building for the Detroit & Cleveland line at the Wyandotte yard of the American Ship Building Co. will be launched Jan. 5.

Friends and business associates of Edward C. Collins, traffic manager of the Pittsburg Steamship Co. were grieved to learn this week of the death of his infant daughter, Miriam Townsend Collins, at Atlantic City, Dec. 16.

The Union liner Binghamton was successfully released at Skillagalee and taken to St. Ignace, where temporary repairs were made before proceeding to Buffalo.

The attention of the minister of marine of Canada has been drawn to the gallantry and humanity displayed by the Pelee Point life-saving crew in rescuing Capt. Moses Boggan and crew from the wrecked steamer Conemaugh on Nov. 22.

The steamer Sheldon Parks, building for W. A. & A. H. Hawgood, of Cleveland, will be launched at the West Superior yard of the American Ship Building Co. on Saturday. This steamer is 552 ft. long, 532 ft. keel, 56 ft. beam and 31 ft. deep.

Howard H. Baker & Co., Buffalo, N. Y., have recently added two new show rooms to their plant, the larger of which is devoted to display of a full line of power boats and engines, and the smaller to accessories. They are also making delivery with motor trucks.

The board of army engineers has reported against either a 22-ft. or 25-ft. channel for the lakes. But a second channel of either 21 or 22 ft. depth is recommended for the mouth of the Detroit river. The cost of a 21-ft. channel is given as $5,528,523, and for a 22-ft. channel $6,670,950.

The steamer R. L. Ireland which was ashore on Gull island was released by the wrecker Manistique and later towed into Bayfield. It was thought for a while that the Manistique had been wrecked in collision with the Ireland, but later this report was found to be untrue. The Manistique had a severe time of it in the gale, but managed to reach port safely.

Capt. James T. Fish, United States navy, has been assigned to Detroit as inspector of the eleventh lighthouse district, relieving Commander J. M. Orchard of Milwaukee, who has been acting as temporary inspector for the eleventh as well as his own district since the promotion of Capt. C. E. Fox. Capt. Fox was an officer on the Yosemite during the Spanish-American war.

CAPT. S. L. VAN DUSEN.

Capt. S. L. Van Dusen, master of the steamer B. L. Pennington, finished his first season as skipper at Tonawanda about six weeks ago. Capt. Van Dusen hails from Trenton, Ont., and has a host of friends.

It is announced that the Northern Navigation Co. of Sarnia which owned the steamer Monarch recently lost on Isle Royale, will build a duplicate of the steamer Huronic.

PLANNING TO PERFECT ITS SERVICE.

At present the Pacific Mail Steamship Co. is planning to complete its service between San Francisco and the Hawaiian islands, and will no doubt operate a special steamer for that purpose. N. P. Wood, secretary of the Hawaiian promotion committee recently arrived from Honolulu and has had a conference with General Manager Schwerin on the subject and thinks that his arguments will prevail.

Secretary Wood shows that present only vessels flying the American flag are allowed to carry passengers to the Hawaiian islands, and that most of these vessels simply touch at the islands on the trans-Pacific voyage, and do not make the round trip. Only one steamer—the Alameda—makes the round trip and she is incapable of handling the heavy traffic.

The Pacific Mail Steamship Co., since the Mongolia and Manchuria have been temporarily put out of commission, has been still farther handicapped in handling the Hawaiian traffic, and it is stated that a vessel to ply between San Francisco and the islands finds favor with the officials of the company.

The new vessel, according to the figures presented to the company by Secretary Wood, ought to make the trip in about four days, or, at least in five. At present the trans-Pacific steamers take from five to seven days.

With the special steamship service for the islands the people over there think they can break into the American fruit trade with results, and that travel to the Hawaiian islands will be greatly augmented.

GRAIN SHIPMENTS.

Following are the receipts and shipments of grain from Duluth for the week ending Dec. 15:

	Receipts		Shipments	
	Dec. 15.	Dec. 8.	Dec. 15.	Dec. 8.
Wheat	1,174,633	1,438,389	1,193,234	3,917,270
Corn	....	....	....	....
Oats	67,845	73,510	11,358	305,573
Barley	267,016	340,816	349,693	679,807
Rye	15,094	9,320	6,465	161,441
Flax	578,190	820,876	150,436	2,980,800

The battleship Connecticut, built at the Brooklyn navy yard, left the yard last week to join the North Altantic fleet for the winter maneuvers. This is the first time in the history of the United States navy that a ship armed and ready for service has gone to sea from the hands of her builders without a trial trip. Naval Constructor Baxter, who superintended the construction of the ship, was elated over the behavior of the great ship.

Naval Architects and Marine Engineers

Naval Constructor D. W. Taylor's paper on "Model Basin Gleanings" was next read. It is impossible to reproduce this paper, owing to the great variety of its illustrations, which not only illustrate the text, but frequently are substituted for the text itself. Readers must therefore have recourse to the actual paper. At the conclusion of the reading of this paper, Naval Constructor Taylor also read Col. Edwin S. Stevens' paper entitled "A Comparison of Durand's and Curtis' and Hewin's Propeller Experiments of 1905," to which the reader must also be referred for its contents.

DISCUSSION.

President Bowles—The two papers are now open for discussion We would like to hear from any gentleman who has any light to shed on the subject, or any questions to ask.

Mr. George R. McDermott—I want to express, in the first place, the debt of deep gratitude which I feel personally to Naval Constructor Taylor for the very great amount of valuable information which he has contributed to the society, not only on this occasion, but in the past two years, particularly in 1904. There are one or two points in these two papers which have just been read that I wish to refer to, Col. Stevens' attempts to draw comparisons between the results formulated by Durand and by Mr. Taylor, and it seems to me that the first step that a reader of that paper must take is to find whether the basis of comparison is correct. In the first place we have to ask the question, does Prof. W. F. Durand, in presenting his results, follow the same plan of presenting the results as did Mr. Taylor; in other words, Mr. Taylor represents the results of an abscissa, or on a basis of the conventional slip ratio based on the conventional or measured pitch ratio. It is not clear to me that Prof. Durand plotted his results on the conventional slip ratio. Is Col. Stevens justified in making a comparison before he makes that comparison? We know that in the Italian tank described by Mr. Froude, and I think also in the Denny tank—we know that in the case of the Brown tank on the Clyde, that they use the effect of pitch ratio, and consequently the effect of slip ratio, whereas Mr. Taylor uses the conventional pitch ratio and consequently the conventional slip ratio. If the gentleman will look at Mr. Taylor's present paper, or any of the diagrams, he will find there three curfes, one named the S value, which is simply the co-efficient of the gross work, the other the K value, which is the co-efficient of the useful work, and the other curve which is the efficient. The co-efficient of the useful work shows a positive value at zero slip. We know, of course, that we cannot get the slip, we cannot have a definite zero slip. The K value is the proportionate quantity, representing the gross value. If we look at any of the diagrams presented by Mr. Froude in his paper, say the Glasgow paper published twenty years ago, in which he attempted to give methods, derived from the results of model experiments, for obtaining the most suitable dimensions of screw propeller, you will find he brings his thrust curve right down to zero and he has incidentally stated elsewhere that he uses the effect of the slip; but we are not in a position to make a comparison between the two; before we are in the position to make a proper comparison between Prof. Durand's results and Mr. Taylor's results, we must be sure as to whether the results as originally plotted are plotted on the same basis. I may say I have gone into the question myself. I took notice wherein the Durand and Taylor results differed. I took Howin's work and Froude's work, Taylor's work and Durand's work and brought them all to a common basis of comparison, and there is not a particle of doubt left in my mind but that Prof. Durand has made an error somewhere. His results do not fall in line with the results of the other three experimenters, but at the same time I would bring that question up in the discussion of Col. Stevens' paper as to whether the basis of comparison is a correct one. I would like also to refer to a previous paper by Mr. Taylor wherein he refers to the efficiency, and makes the remark that hitherto it has been customary to believe that a greater efficiency than 70 per cent could not be obtained, or about 70 per cent; he had in mind the published results of Mr. Froude, which is somewhere about 69, as I remember. Then he refers to that famous propeller, in which he obtained an efficiency, I believe, as high as 78.8. Now, may it not be that Mr. Taylor's results were plotted upon the same basis as Mr. Froude's, that the disparity between the efficiency found by those two gentlemen might perhaps not disappear, but be brought nearer together. From some rough approximations I have made, I find, it appears, that if they were plotted on the same basis, Mr. Taylor's efficiency of 78.8 would approach somewhat nearer to 74 or 75, which is certainly closer to the 70 than the 78.8.

Capt. William Hovgaard—I believe the experiments carried out by Mr. Taylor on the measurement of pressures and sub-pressures in the vicinity of a propeller are the first ever made in this direction. The results are very suggestive in several ways; first, as regards the problem of cavitation, they appear to me to corroborate the English theory, advanced by Mr. Barnaby, and I believe by Sir John Thornycroft, that cavitation takes place when the mean thrust per square inch reaches a certain value, for this is really equivalent to saying that the sub-pressure created forward of the propeller is proportional to or at least a function of the mean thrust. Now, if we read what Mr. Taylor says in his paper that "the reduction of pressure is almost a constant fraction of the thrust per square inch," it appears to correspond well with that theory. There is another theory advanced in explanation of the phenomenon of cavitation, namely, that of Mons. Normand; he holds that there is a certain maximum value of the acceleration given to the water which must not be passed. If this acceleration, which depends on the immersion of the propeller, is exceeded, the water will be unable to follow the propeller, and cavitation will take place. The two theories differ inasmuch as the change in velocity in the stream lines forward of the propeller is for a given sub-pressure not the same at different speeds, but is much smaller at higher speeds.

Another point to which I would draw attention is that, as the curves of pressure show, and especially curve C (that for the center line) the sub-pressures are always greater than the pressures found after the propeller, showing, so it appears, that the greater part of the total thrust of the propellers is due to suction, the smaller part to excess of pressure. Finally, in regard to the fact that, at the greatest distance from the pro-

peller at which observations were taken, the pressure along F was negative throughout the length of the plane, I would ask Mr. Taylor how he explains this. It seems to me that it might be due to the suction caused by the propeller race, regarded as a huge stream line, in which the velocity of flow is for reasons accelerated beyond that of the surrounding water. Round the envelope of such a stream line we may, I believe, expect a sub-pressure to exist.

Mr. C. C. Thomas—May I suggest that as Mr. Taylor will probably speak about these different efficiencies, at least I hope he will, for my benefit, the efficiencies determined by different experimenters, as I have wondered a great deal in looking at these results from time to time, upon what basis the efficiencies were produced or calculated, might I suggest that the point Prof. McDermott has brought up would be clearer to us if we could induce him to put upon the board that diagram as indicating the slip as abscissa to show what is meant by figuring the thrust at zero slip and at positive slip. I think that would clear up the matter somewhat, if Mr. Taylor will speak on that particular point.

Mr. Charles E. Hyde—I notice it is the custom of the designers of propellers to try different pitches for different parts of the blade, both radial and behind the heels. I had occasion to measure up some ordinary wide blades on tow boat wheels some time ago, made by a firm which had made something of a reputation, and I found somewhat to my surprise that in nearly all the wheels the pitch was coarser near the hub than further out on the blade. On a 6 ft. wheel the pitch was 8 ft. for most of the blade and about 9 ft. near the hub. I would suggest that Mr. Taylor, when he is making further experiments, if he has not already done so, that it would be interesting to have some wheels tested which vary in different ways, which would perhaps give us some light as to whether there is any superior efficiency in a blade of that shape.

Prof. Furer then read the remarks of William McEntee, assistant naval constructor at Mare island navy yard, which will be published later.

Prof. Peabody—I regretted very much when the list of articles to be read before the Society came out, that an article which I knew our assistant naval constructor had written did not appear among the list, and this paper seems to explain the reason why it did not. I had the pleasure of seeing this paper in preparation, and had pleasure in expecting to hear it read here. May it not be possible to have that presented as an original paper by Mr. McEntee, and if he sees fit to make some minor changes, he shall still have the opportunity of presenting the paper in regular order under his name, and not as a discussion. Can the chairman inform me whether such action can be taken?

The President—I personally should not think there would be any objection. The secretary says that it was crowded out simply because it was not received in time to be printed. It would be an easy matter to take the sense of the meeting to find out if there is any objection to having the paper appear as if it had been received in due season and put in print before the meeting.

Prof. Peabody—If there is no objection, I move that Mr. McEntee be granted permission to present his discussion as an original paper, even though it had to be explained that it came too late to be included among the regular list of papers.

Mr. D. W. Taylor—I would like to second the motion. I, too, have had the pleasure of seeing the paper and consider it a very valuable one.

The motion was carried.

Prof. Peabody—I think the title of Mr. Taylor's paper will almost tempt one to accuse him of an undue appearance of modesty, except that this paper in quantity does not cover the field as his preceding papers have. It is an individual part of the same piece of work, and of course it is a subject which is at present in our minds. Further, it is clear to us that, knowing Mr. Taylor as we do, he will eventually bring all of this matter together and present to us means of designing propellers based upon his investigations, which shall be practical and simple, and which can be used with great confidence. It is possible to design propellers from the information given us now, the only trouble about that being we must have, of course, the entire amount of information at hand and must practically interpolate on his curves. That that can be readily done I know, having tried it myself, and results can be obtained in that way which are satisfactory, without any question.

The President—The authors of the papers will now be given an opportunity to reply. As Capt. Taylor is the only author present, I believe Mr. Cox will take care of Col Stevens' reply.

Mr. D. W. Taylor—With reference to Prof. McDermott's remarks, while I am not positively informed, I believe that Prof. Durand in his paper last year plotted the results upon nominal pitch ratio, the same as I did, but I do not believe the discrepancy between his results and the results of other experiments, including myself, pointed out by Prof. McDermott, was due to any error in the experiments. You will find, on looking up the matter, that the screws with which Prof. Durand experimented differed radically from those with which I experimented, and I presume those others to which Prof. McDermott referred. Prof. Durand's series of screws, you will find by referring to his paper of 1897, varied in blade width from a very broad blade to a very narrow width, but as he decreased the width he decreased the thickness of the blade in proportion, I think Col. Stevens was slightly in error in his paper in saying that Prof. Durand's blades were made to represent average practice. It was, a fact that some of the blades of the medium width he intended to represent average practice, but the very broad blades were probably thicker than the average practice, and the very thin blades were distinctly thinner than the blades with which I experimented. I think they were only half the thickness of my narrowest blade, because in my experiments I kept the maximum thickness of the blade constant, regardless of the width. The result was that Prof. Durand's narrow blades were much thinner than mine, I think only about half as thick, the very thinnest. Any one who wishes to see the effect of the variation of thickness with the narrow blade will find, in referring to Fig. 5 of my paper, that that shows the effect of variation of thickness on rather a narrow blade, but not quite as narrow as Prof. Durand's narrowest. The effect of doubling the thickness seemed to be very great, but it is in the right direction; that is to say, the thinner blade absorbed very much less power and gives very much less thrust than the thicker blade. You will find, on referring to Col. Stevens' paper, that is exactly the direction in which the results of Prof. Durand and myself differ. Prof. Durand favors blades absorbing much less power and giving much less thrust than the thicker blade. As regards the very broad blades, there is not so much difference; Prof. Durand's results are below mine, but you should consider in that connection his blades were elliptical instead of full ended, and you will find in the other

figures the shape of the blade face has an appreciable effect, so that for a given area ratio they would deliver less thrust and absorb less power than those of the full ended type which I used. There is no data to show the exact shape Prof. Durand used, and there may have been some other minor differences in section which would affect his results, but the effect of thickness and blade shape is, in my opinion, enough to account for the difference between his results and mine, without assuming material error in his results or mine. The effect is not only as regards the power and thrust, but there is a decided effect on the virtual pitch to which Prof. McDermott referred.

Referring again to Fig. 5, these curves are not carried down to the negative nominal slip. If they were carried down to negative nominal slip, you would see that the thin blades would reach zero thrust at a much smaller negative slip than the thick blades. If Col. Stevens' results were modified, showing the results were plotted in each case for the virtual pitch, instead of nominal pitch, you would find the curves of efficiency would be remarkably close. That has been practically done by Mr. McEntee, who has plotted results, not upon the nominal slip, but upon the thrust of propeller. That substantially reduces them to the same virtual pitch and causes, as he shows by an example of curves, the efficiency to come very close together. As regards the maximum efficiency, I do not see how the change in method of plotting results could affect the maximum efficiency. At the time of my 1904 paper, when I gave an efficiency of 78 and more for three-bladed screws, I hesitated a good deal before publishing such high efficiencies, but I could not get them lower from my experimental results. Since then Prof. Durand published his results last year with four-bladed screws, which naturally have less efficiency than three-bladed screws; he found efficiencies of 74 per cent. I have also reliable information to the effect that Mr. Froude made a number of experiments on propellers, later than his classical experiments, published twenty years ago, and also found efficiencies reaching as high as 75 per cent for three-bladed screws. The efficiencies, as you will find on reference to my original paper two years ago, eliminate practically the effect of the hub as plotted by me. Prof. Durand excludes the effect of the hub, and as regards maximum efficiencies we may be said to be in close agreement.

With regard to Capt. Hovgaard's remarks, I am sorry I cannot agree with him in concluding that the results show that the thrust per square inch is the prominent factor in causing cavitation rather than the acceleration. As a matter of fact I do not see there is much difference. The thrust per square inch is more or less proportional to the acceleration. In the experiments given in this paper, as you approach cavitation, the slip does not change very much, before the speed of the screw commences. You have comparatively little cavitation, but get enormous increase in thrust and acceleration of the water, owing to the natural increase in velocity of the screw. I have been personally inclined to think that cavitation is largely affected by the blade section; in other words, that you might find a form of blade section which would produce much less acceleration of the water for a given thrust, or a very much less violent variation in acceleration of the water for a given thrust, than in other forms. Cavitation appears to be sought to be avoided nowadays by increasing the width of the blade, necessarily accepting the increased friction loss involved. As you increase the width of the blade, holding constant the maximum thickness, you decrease the angle of entrance, if I may so express it, and I think the gain is from decreasing the angle of entrance rather than from decreasing the thrust per square inch, as a result of the greater area.

I would invite attention to the paper of two years ago, in which a model screw gave signs of cavitation at five knots; at six knots it gave distinct cavitation, and at seven knots showed very pronounced cavitation, but at a very much lower thrust than it began to show cavitation at five knots. I think the thrust was probably not over half that. At five knots you can get twice as much thrust out of the screw, before you get cavitation, than at seven knots. The difference was that at seven knots the velocity of the screw through the water was very much greater; it was clear that the cavitation was due to the blade actually splitting the water; whether that would apply to full size screws I would not like to say.

As regards the method of calculating the efficiencies referred to by Mr. Thomas, that was also fully described in my 1904 paper. The efficiency, however, was taken at the ratio between the work absorbed in a given time, determined from the measurement of torque, and the useful work taken as the thrust multiplied by the distance traversed by the screw in the same time. The efficiency was simply the ratio between the useful work and the work absorbed by the screw. There is no other true efficiency I know of. We determined the efficiency without considering the slip, although it was afterward naturally plotted on the slip as this was convenient. As regards Prof. Peabody's remarks, I would be glad some day to attempt to combine this data into more simple form and reduce it a little more to rule, but purposely in these papers we so far have given as nearly as possible the original data, so that any one who wished could modify it or transform it in any way he wished for design purposes. I am aware of several people who have used them for design purposes, having reduced them to rule, but each use a different method and each man thinks his own the best. Mr. McEntee's suggestion that experimental results be plotted in standard form might be useful, but it seems to me it would be more desirable to make sure that the experimental results are fully given, so that they can be reduced to any form desired. Col. Stevens also leans in that direction, evidently, because he is doing a good deal of work in comparing the two. Although Prof. Durand's results and mine were apparently critically different, Col. Stevens found a satisfactory method of reducing them to a common basis and getting a reliable comparison.

The President—Owing to the absence of Col. Stevens and the declination of my friend Cox to try to fill his place, the reply on behalf of Mr. Stevens' paper will have to be passed over.

This completes the list of papers for today. We will not take up any further papers this evening, as those who could not get here today are counting on certain definite papers to be considered tomorrow. We will now adjourn.

Three steamships that have been in the coasting trade will at once sail from San Francisco to Central America to enter the coffee traffic. These vessels are the Indiana, formerly in the Seattle-Alaska trade, the Barracanta, and the Aztec. These vessels are controlled by the Pacific Mail Steamship Co., and will ply between the various coffee exporting ports and Ancon.

FLOATING A WRECKED SHIP WITH COMPRESSED AIR.

(From the *Engineering Record.*)

The Bavarian, a 12,000-ton, steel steamship of the Royal Mail line, which was impaled on Wye Rocks, in the St. Lawrence river, on the night of Nov. 3, 1905, was recently floated by using compressed air to force the water out of her damaged compartments. The ship's bottom was badly damaged, many of the compartments were filled, and as the vessel settled down on the rocks her engines were forced up so that the inner funnel showed 18 in. above the rim of the outside one. The wreckers who made an examination declared that the floating of the vessel would be a very difficult job. After the owners had spent several weeks in fruitless attempts to raise her they gave up and the London Lloyds undertook the work. All the ordinary methods were tried. Pontoons lashed alongside and empty oil barrels stored in the hold failed to float the vessel as the tide rose. Chains run under the bow and stern and attached to winches on powerful lighters did not move the ship when the attempt was made to raise her. Finally the underwriters announced that they would receive bids from parties who believed they could save the ship. Accordingly a contract was made with Captain Leslie, of Kingston, who had determined to make another attempt by the usual methods. About this time Messrs. Robt. O. King and William Wotherspoon, of New York, approached Capt. Leslie with a plan which he accepted, joining with these engineers in the salvage scheme. A plant, well equipped with compressed-air machinery, was purchased, and a crew of men accustomed to work in compressed air was secured among the tunnel workers about New York.

The ship's bottom was torn so severely that the holes were too large to patch, otherwise the water might have been pumped out. It was therefore decided to force the water out with compressed air. All the compartments were made as tight as possible and the hatches closed by plating which was laid under the hatch combing so that when air pressure was applied the covers would be held in place. Air-locks were placed on the compartments which had filled with water. As the air was forced in the water receded and the workmen were able to stop the leaks with temporary plating. One of the most troublesome leaks was in the fourth peak tank, which in the Bavarian is a ballast tank of about 115 tons capacity. An air-lock was not placed on this tank, but the manhole cover was put in place and the compressors operated until the tank was practically empty. The cover was then removed just long enough to allow two men to drop through into the tank. The pressure was then once more applied and the water forced entirely out, so that the workmen could repair the leaks at their leisure.

On Nov. 16 there was a prospect of an unusually high tide, and it was decided that advantage must be taken of it in spite of a gale blowing and bad weather. Accordingly, as the tide rose the compressors were started and full power of the plant was devoted to forcing air into the hold of the ship. The great hulk was thus lifted from the rocks and floated clear. There had been some fear that the vessel might turn turtle or that the air pressure would not hold the water back, but these doubts were soon set at rest, for the ship remained on a nearly even keel. Tugs took her in tow for Quebec, and she was beached there in Wolfe's cove.

AIR COMPRESSOR LUBRICATION.

One of the dangers in air compression, says *Engineering Magazine,* which has not been fully recognized until within a quite recent period, is the liability to explosion in air compressor cylinders when the heat of compression is caused to exceed the flashing-point of the oil used for cylinder lubrication. Several more or less serious accidents of this nature have been recorded within a period of three or four years.

With this statement in mind, and with an abundance of data to draw from, the Joseph Dixon Crucible Co., Jersey City, N. J., draws attention to the many striking advantages of Dixon's Ticonderoga flake graphite as a cylinder lubricant for air compressors.

Among other features Ticonderoga flake graphite is unaffected by high temperatures. It cannot be "carbonized" or ignited. It cannot possibly give off explosive vapors. It will not accumulate dust or grit. It does not clog discharge valves. It allows a great reduction of oil supply. It avoids the danger of receiver explosions. It improves piston fit and lowers friction. It saves oil, repairs, trouble and money.

A wealth of interesting data and information on the subject of air compressor and air drill lubrication is presented in a twenty-four-page pamphlet, which is sent free of charge to all who are interested in the subject.

THE WYOMING TO USE OIL FOR FUEL.

Rear-Admiral William S. Cowles, chief of the bureau of equipment, recommends in his annual report that in future all battleships to be constructed have double bottoms, with a view to carrying oil in them, and that all necessary pumps, pipes, and appliances for burning oil be placed on board. The department, according to the report, has directed that the monitor Wyoming be prepared for using fuel oil, and plans for placing oil tanks in the bunker spaces have been made. Experiments will be made with the Wyoming to determine the practicability of constructing a vessel along lines which will provide for the sole use of oil as a fuel. The report, however, says that as fuel can be obtained in a very limited number of places as compared with coal, and as the general use of oil would soon reduce the supply to such an extent as to make the price prohibitive, the bureau believes that the designs for new vessels should be in accordance with the present practice with regard to the allotment of space for the storage of coal.

MISCELLANEOUS ITEMS.

The steamer Antilles, the second of three steamers building for the New York-New Orleans service of the Southern Pacific railway, was launched at Cramp's ship yard recently. The Antilles is 450 ft. long, 53 ft. beam and displaces 10,000 tons.

The Erie railroad has issued an announcement that the fire at Hotel Riverside, Cambridge Springs, Pa., was small and that the hotel is in operation and without any inconvenience to the guests.

The six-masted schooner Alice M. Lawrence was launched from Percy & Small's ship yard, Bath, Me., for J. S. Winslow & Co., Portland, Me., last week. The schooner is 305 ft. long, 48 ft. beam and 32 ft. deep.

The armored cruiser Montana was launched at the yard of the Newport News Ship Building & Dry Dock, Newport News, Va., on Saturday last, and was named by Miss Minnie Conrad, daughter of W. G. Conrad, of Montana.

The responsibility for the collision in Hampton Roads recently between the battleship Virginia and the steamer Monroe, has finally been determined by the supervising inspector general of the steamboat inspection service who holds that the Monroe was at fault. The naval court of inquiry has absolved the Virginia's officers from blame.

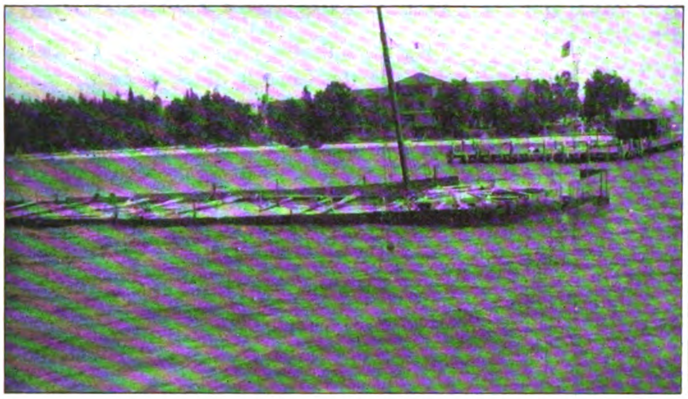


FIG. I.—BOW VIEW WITH COFFERDAM IN PLACE.

FIG. 2.—STERN VIEW WITH COFFERDAM IN PLACE.

WRECKING THE STEAMER JOHN DUNCAN.

Capt. Alex Cunning, master of the Great Lakes Towing Co.'s wrecker, Favorite, has closed his first season with a record of brilliant performances in his position as wrecking master. Whatever he undertook, he succeeded at, and one of his cleverest operations was when he raised the steamer John Duncan, which went down in Lake Michigan off Northport in collision with the Anchor liner Lehigh last June. The accompanying half tones tell the story better than words can. Pictures one and two show the Duncan's bow and stern with the cofferdam in place ready to pump. No. 3 shows inside the cofferdam before the pumps were started. No. 4 shows vessel pumped out before the cofferdam is stripped off. Nos. 5 and 6 show the bracing inside the dam. Capt. Cunning raised the Duncan the first week in September and she was towed to Milwaukee.

FIG. 3.—INSIDE THE COFFERDAM BEFORE THE PUMPS WERE STARTED.

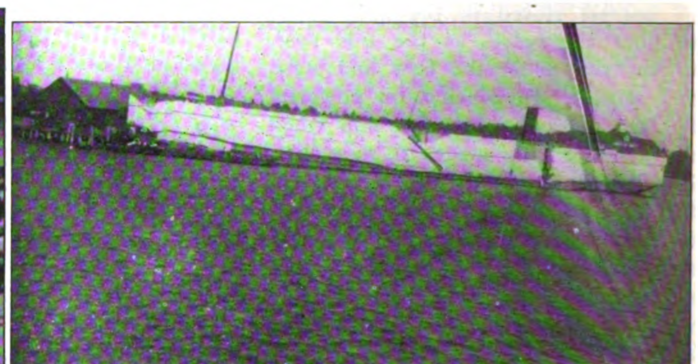


FIG. 4.—SHOWING VESSEL PUMPED OUT BEFORE COFFERDAM IS STRIPPED OFF.

The steamer Monarch of the Northern Navigation Co.'s fleet, is a total wreck on Isle Royal, having gone ashore on Sunday on a rocky reef. The Monarch left Port Arthur on Saturday, bound for Sarnia. The steamer had ten passengers and a crew of thirty on board. They succeeded in reaching the shore, but suffered greatly thereafter, as there was no shelter available and the weather was below zero.

The Hudson River Day Line will build a duplicate of the Hendrick Hudson to be named Robert Fulton. The new steamer will be designed by Mr. Frank E. Kirby.

It cost $19,604,749 to keep the ships of the navy in commission during the past fiscal year.

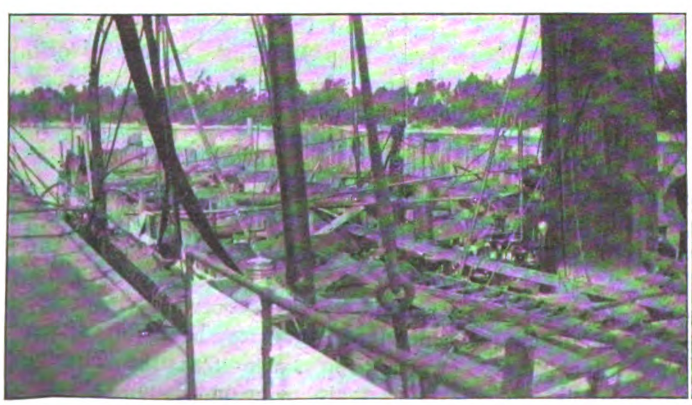


FIG. 5.—SHOWING BRACING INSIDE THE COFFERDAM.

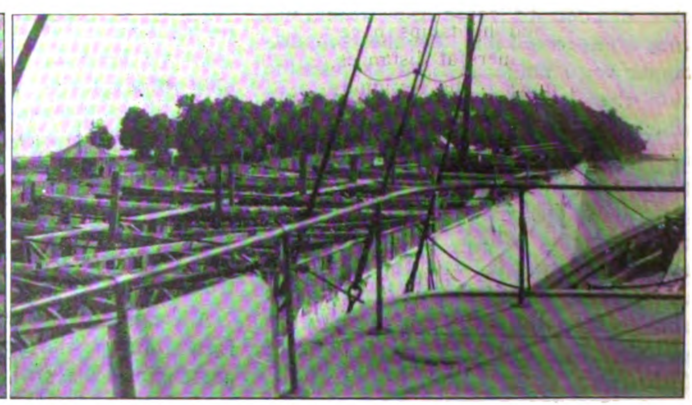


FIG. 6.—SHOWING BRACING INSIDE THE COFFERDAM.

SUBMARINE SIGNALS ON LIGHTSHIP KEWAUNEE.

The Submarine Signal Co. Boston, is to equip the lightship Kewaunee, stationed at Southeast Shoal, Point Au Pelee, Lake Erie, with its submarine signaling apparatus, making the first installation of this exceedingly valuable aid to navigation on the great lakes. The lightship Kewaunee is maintained by the Lake Carrier's Association. Mr. Charles Moore, the chairman of the board of directors of the Submarine Signal Co., arranged last week with President Livingstone of the Lake Carriers' Association, for the equipping of the Kewaunee with this apparatus. Since its organization a little more than a year ago, the Submarine Signal Co. has rapidly equipped the dangerous points on the Atlantic coast with its apparatus, so that today vessels are guided by submarine signals from Cape Hatteras to Halifax. The lighthouse board authorized its installation upon ten lightships, but nineteen have altogether been fitted, it being the policy of the company to keep well in advance of the government in equipping lightships. The system has also been introduced generally throughout Canadian waterways and its installation is now under way on the Pacific coast. There is no body of water, however, in which the system can render better service than on the great lakes, since the channels are contracted, reefs numerous, fogs frequent and a leeshore ever present. Had such a system been installed on Gull Island reef, the strandings of the Corey last fall and the Ireland this fall, would not have happened.

As an aid to navigation the system of submarine signaling is incomparable, because it is possible to locate the direction of the sounding positively. The general direction of sound traveling through the air cannot be determined, but traveling through the water it can be absolutely defined by the receiving apparatus aboard ship. The installation of the receiving apparatus aboard ship is inexpensive.

The system has been adopted by practically all the liners in the north Atlantic service, and lightships have been picked up by the liners at distances of from five to ten miles. The testimony of the captains of these liners make the strongest possible endorsement of the system.

The steamer Robert Holland and consorts Ida Keith and Exile were libeled for $12,000 at Marine City last Saturday by the Nester estate, owners of the steamer Schoolcraft, for salvage. The Holland was picked up by the Schoolcraft in a crippled condition off Point Abbage, Lake Superior, Nov. 27. Bond was furnished.

THE PARTS OF A SHIP.

From THE IRON TRADE REVIEW.

Following is a list of ninety-seven different articles that entered into the cost of an American freight steamship, 500 feet long, of about 10,000 gross tons register, built in an American ship yard two or three years ago. We present the articles, with their cost, in order that readers of the IRON TRADE REVIEW may see to what an extent they are interested in the building of our shipping:

Plates	$127,920.00
Ribbed steel plates	764.00
Shapes	60,654.00
Bar iron	8,800.00
Bar steel	1,613.00
Forgings	13,425.00
Iron castings	17,557.00
Steel castings	5,244.00
Sheet iron	1,085.00
Malleable iron castings	172.00
Brass castings	8,816.00
Manganese bronze castings	7,555.00
Rolled brass	5,181.00
Bearing metal	2,808.00
Rivets	13,550.00
Bolts, nuts, etc	3,100.00
Lumber	10,274.00
Hardware	423.00
Glass	262.00
Paint materials	6,918.00
Pipe and tubing brass and iron	6,913.00
Copper	5,174.00
Pipe fittings	1,090.00
Plumbing materials	600.00
Screws	367.00
Nails	119.00
Wire rope	911.00
Manila rope	1,454.00
Wire	13.00
Gum	279.00
Sheet lead and pipe	650.00
Sand	25.00
Cement	727.00
Zinc	55.00
Chain	110.00
Tallow	453.00
Oils and grease	287.00
Coal	1,141.00
Packing	501.00
Valves	1,819.00
Safety valves	356.00
Pressure reg.	366.00
Oakum	36.00
Cotton	15.00
Pitch	23.00
Bricks	48.00
Wire work	40.00
Radiators	16.00
Windlass and capstan	3,644.00
Steering engine	6,200.00
Hoisters	6,300.00
Pumps	4,675.00
Blowers	1,700.00
Feed water heater	487.00
Evaporator	1,020.00
Signals and speaking tubes	992.00
Blocks	911.00
Thimbles and shackles	112.00
Spars	937.00
Boiler tubes	4,686.00
Boiler furnaces	4,800.00
Tools	256.00
Gauges	224.00
Lubricators	26.00
Asbestos	147.00
Metallic packing	257.00
Springs	30.00
Life boats	452.00
Anchors	1,708.00
Anchor chains	4,414.00
Bells	55.00
Whistle	80.00
Nautical instrument	735.00
Running lights	193.00
Life preservers	60.00
Hose	250.00
Boiler and pipe covering	510.00
Life gun	80.00
Flags	75.00
Axes	15.00
Fire buckets	10.00
Electrical equipment	2,947.00
Canvas work	920.00
Printing	40.00
Stoves	250.00
Kitchen utensils	294.00
Glassware and China	115.00
Cutlery and Silver	162.00
Upholstery	350.00
Furniture	700.00
Bedding Inc. mattresses and blankets	700.00
Linen	200.00
Carpets	175.00
Mirrors	60.00
Medicines	50.00

ITEMS OF GENERAL INTEREST.

Mr. John J. Joyce, president of the Buffalo Grain Scoopers, has been elected secretary and treasurer of the Long shoremen's Association to take the place of Mr. Barter, resigned.

The lake steamer John C. Howard, which is going to the Pacific coast, has arrived at New York with a lumber cargo. She will fit out at Baltimore for her voyage around the horn.

The steamer F. H. Prince while entering the harbor of Ogdensburg this week was cut through by the ice and 5 ft. of water admitted into the hold. The cargo was partially damaged.

Mr. Frank E. Kirby returned to Detroit on Friday last from New York. On Monday he made an examination of the State of Ohio with Mr. Parry Jones, underwriters' representative.

Nine or ten plates will have to be removed from the steel barge Sir Isaac Lothian Bell injured in collision with the steamer Rogers at Port Huron, and now at the Ecorse yard.

The new car ferry No. 4, recently built in Cleveland for the Ann Arbor railroad, arrived in Frankfort, Mich, last week and was given a general reception by vessels in the harbor.

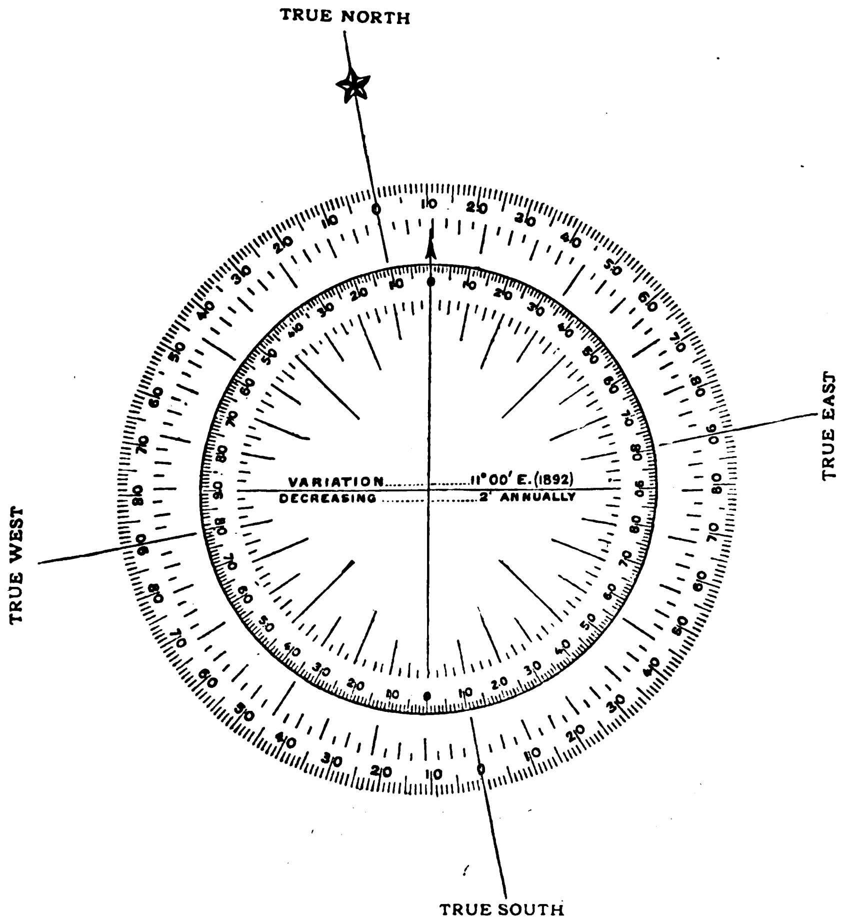
The steamer James F. Morrow was launched at the Lorain yard of the American Ship Building Co. on Saturday last and was christened by Mrs. L. W. Leiter of Duluth, daughter of Mr. Joseph Sellwood, owner of the vessel. The Morrow is 440 ft. over all, 420 ft. keel, 52 ft. beam and 28 ft. deep, and will have triple-expansion engines and Scotch boilers. Her carrying capacity is 7,500 tons.

SCIENTIFIC LAKE NAVIGATION

By Clarence E. Long

CORRECT MAGNETIC COURSE TO TRUE COURSE.

It often times occurs that it is necessary to convert a correct magnetic course, or bearing, into a true course or bearing, and also a "magnetic" course or bearing into a true course or bearing. (It must be plain to the student that the rules for converting



EASTERLY VARIATION OF THE COMPASS.

a correct magnetic course to a true course are the reverse of from true to correct magnetic.) Both rules are the same, and as the process is the reverse of the true course to the correct magnetic course, the rules are simple ones and are as follows:

Variation easterly allow to the right.

Variation westerly allow to the left.

That is, Ely. Var. to the right of the C. M. C. to obtain the true course; and Wly. Var. to the left of C. M. C. to obtain the true course.

Before proceeding further with this subject, we will first explain the manner in which these courses or bearings are employed and their usage:

A steam vessel, or a sailing vessel with a fair wind, can lay a straight course between her point of departure and her point of destination, and run on it without changing the course. In a case of this kind the Var. can and always should be allowed for beforehand, that is, the true course found should be converted into its corresponding correct magnetic course by applying the amount of the variation between the places sailed thus counteracting the effects of the variation all along the course in the first place.

But for a sailing vessel beating to windward this cannot be done. She is put as close to the wind as she will advantageously sail, and on the tack lying closest to her course (providing there is ample sea room) and whatever the course shown by compass is noted. This then, is purely and simply a "magnetic" course (provided there existed no deviation for that point of the compass steered, and for sake of simplicity, we will say there is none.) If there were deviation then the course would be the compass course (a compass course is a true course affected by both variation and deviation, or a C. M. C. affected by deviation only; all of which is fully explained in another chapter.

Here seems a good place to explain what a "magnetic" course or bearing is: A "magnetic" course or bearing is the natural direction pointed out by the compass needle when out of reach of all magnetic influence except that of the earth, which controls it; that is, from all effects causing deviation and "local attraction."

Now to go on with a vessel beating to windward, and the course she would steer. To determine the true course run so as to lay it down on the chart to find and keep the ship's position, it is necessary to convert this "magnetic" course to a true course by applying the variation existing on the course; for it must be plainly seen that the course steered is not the true course, unless, however, it happened that there was neither variation nor deviation for the point of the compass steered on. This would seldom be the case.

As the vessel sails on these various courses it is necessary to convert them into true courses so as to keep track of her position, and according to the last two rules, these are: Easterly to the right, and westerly to the left of the "magnetic" course steered to arrive at the true course run. The student must bear in mind that the course run is affected by the variation, which has not been allowed for. If not allowed for in the first place easterly variation will carry you to the right of the (supposed true) course you are steering by the amount of the variation existing, and westerly variation to the left of the (supposed true) course you are steering by the amount of the Var.

DIFFERENCE BETWEEN "CORRECT" MAGNETIC AND "MAGNETIC."

An example will explain this, and also the difference between "magnetic" and correct magnetic.

Supposing the case of a vessel put on a tack closehauled to the wind, and the course as shown by compass was NE (bear in mind that this is only in case of no deviation existing) and she sails on this course for several hours, the Var. being we will say ½ point westerly, which is equal to about 6 degrees; what is the true course or direction that she has been sailing in?

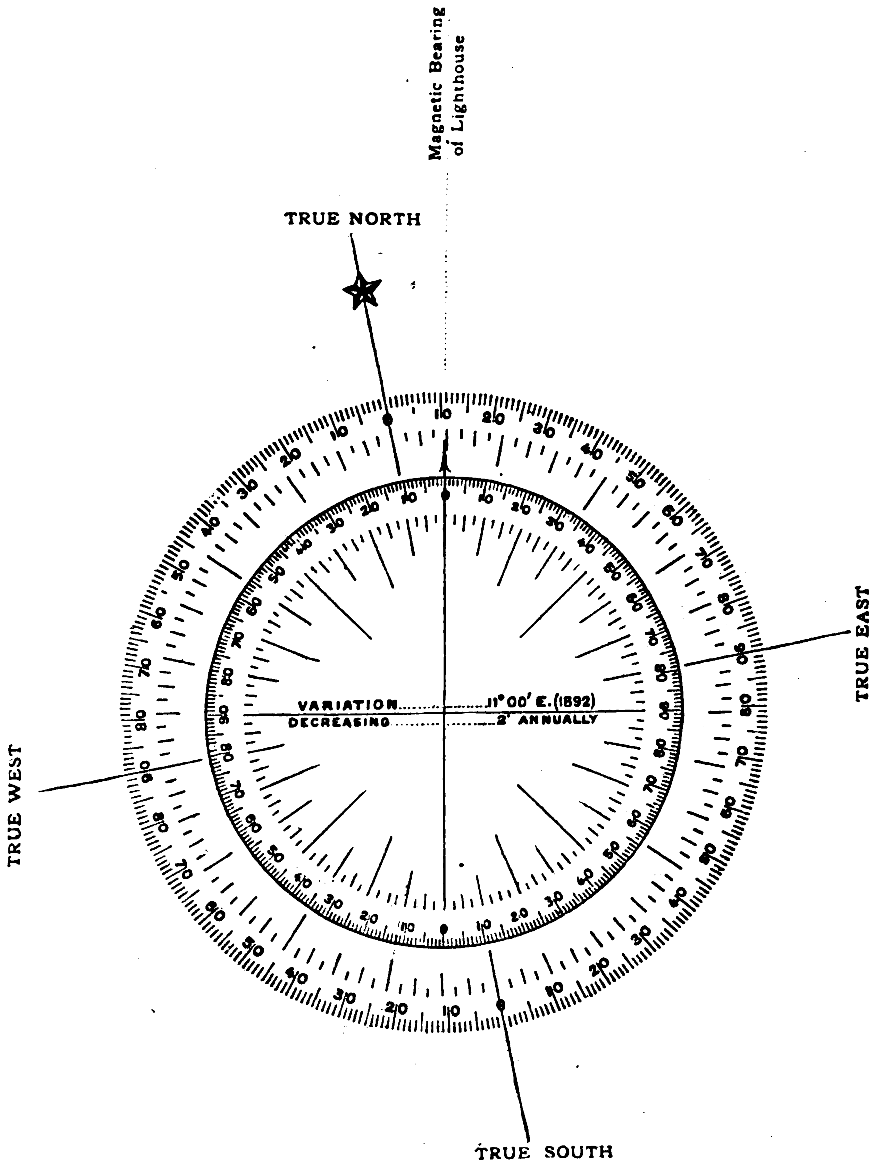
Westerly variation throws or carries the vessel to the left of the (supposed true) course steered; consequently the vessel has been steering ½ point to the left of the course as shown by the compass, making the true course run NE½N. The magnetic course in this case is NE, and the true course NE½ N (bear this in mind.) Now, if it were desired to steer, or make good, a true course of NE in the first place, with ½ point Wly. Variation in a steam vessel, or a sailing vessel with a fair wind, we would have to steer NE½E, which is the correct magnetic course, the true course corrected for variation.

To illustrate and prove this go over these courses on the accompanying chart compass diagrams, which shows the variation of the compass to be 6° Wly., = ½ point. Find NE on the inner card (magnetic compass) and then run this point out until it coincides with a point on the outer card. It will be found that NE on the inner card corresponds with NE½N on the outer card; hence, to steer NE by a compass affected by ½ point Wly. Var., the ship would in reality describe a NE½N true course.

Therefore, NE is the magnetic course and NE½N is the true course corresponding thereto. Now, to steer NE true in the first place with this amount of variation—find NE on the outer card (true compass) and then move in to the inner card to the point which coincides therewith. NE true corresponds with NE½E on the inner card, and represents the correct magnetic course, because the true course has been corrected for variation. Does this not bear out the rules, laws and principles governing the application of the variation as already given? To find the correct magnetic course from the true course, find the true course on the outer card and move in. To find the true course from the correct magnetic course, find the correct magnetic course on the inner card and then move out to the outer card. A little practice, a little patience and a little perseverance on the part of the student, will render this all very plain.

TAKING A MAGNETIC BEARING.

Again, supposing you had a compass on shore, in a place free from local attraction (away from iron or steel, or anything made up of these substances, such as a boiler or machine shop, mill or factory, powerhouse, railroad tracks, steel lighthouse tower, and other things too numerous to mention) and nothing but the earth's magnetism to influence it, and you desired to take a bearing of an object, say a lighthouse situated on a neck of land some miles distant from the spot where you and your compass are located. You take the bearing and you find that it is north by compass; this then is the magnetic bearing (read definition of magnetic bearing again), and you know for the position that you are in the Var. is 1 point Ely. Now, if the "magnetic" bearing is north and there is one point of Ely. variation, what is the corresponding true bearing, that is, what points on the magnetic card of the compass coincide with the true points of the horizon, or in other words, how would the compass read on this bearing were there no variation.



HOW THE COMPASS IS SLEWED.

You know that every point of your compass is slewed to the right one point of the true points, caused so by the earth's magnetism producing the variation. Thus, if north is slewed to the right all the other points must be slewed the same amount and in the same direction; hence the true points corresponding to the magnetic points are to the left of the magnetic points with easterly variation and to the right with westerly variation. North magnetic coincides with N by E true; east magnetic with E by S true, and south magnetic with S by W true and so on round. (Just try this on your portable card.) Then to find the true course or bearing, the variation being known and stated, allow easterly variation to the right of the magnetic point given, and westerly variation to the left; i. e. (i. e. means that is) you must move over the edge of the card from the point being corrected, and do not imagine that the card is doing the moving. Mistakes are liable to occur from this source if the student is not careful to bear this in mind. Remember the card has already moved

from the true points by the amount and direction of the variation, under the influence of the earth's magnetism, which produces it.

THE LOGIC OF IT.

Do you see that north "magnetic" with one point of easterly variation will coincide with the true N by E point of the compass. (See chart compass diagram showing 11° easterly variation.) Remember that the outside compass represents the true points of the observer's horizon, and the inside compass, the compass affected by the earth's magnetism causing the variation, and which can and may represent the magnetic directions of the observer's horizon. Make the two norths coincide (no variation); now swing the inside compass to the right one point, affecting easterly variation. Where does magnetic north come on the true compass, as well as the other points of the inside or magnetic compass? Do you see that in order to get the true directions from the "magnetic" directions that you have got to move to the right on the "magnetic" compass for easterly variation and to the left for westerly variation.

ANOTHER WAY OF PROVING IT.

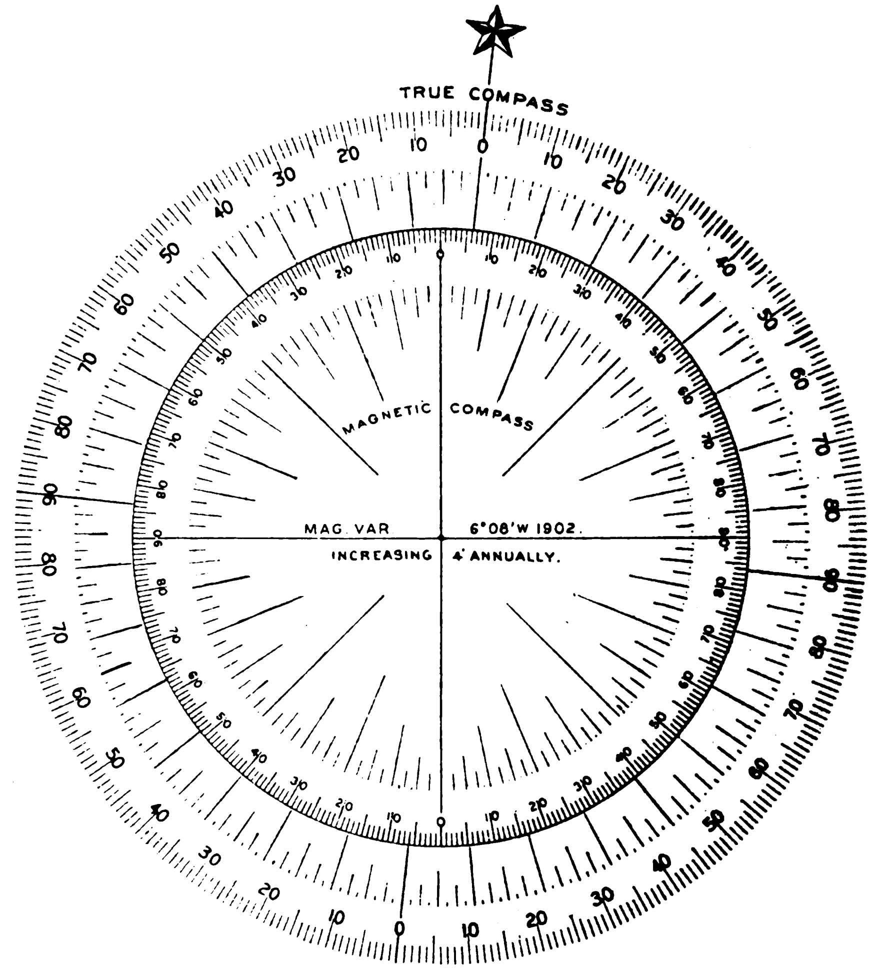
To prove this example in another way: After you have slewed the inside compass to make north magnetic coincide with N by E true, just swing the card back, making variation zero, does not N by E on the inside compass coincide with N by E true? Of course it does.

Now, do not get this "magnetic" course or bearing mixed up with something else. Picture it in the mind's eye, and go over and through the conditions just as they exist in every case and you cannot fail to clearly comprehend the significance of its real meaning. Do not get this matter turned end for end by reading from the outside, or true compass, to the inside compass; if you do the conditions will be actually reversed, and what we have already said rendered meaningless. Remember the rules, and also remember that they do not change, and be sure not to let your mind wander away on something else, that seemingly, bears out these conditions, but which would require a change of the rules here stated. We know how this is, especially in a case of this kind, for we have been there. Stick to the main trail and you will be sure to come out all right.

WHEN THEY ARE THE SAME.

In this last case "magnetic" course or bearing, and correct magnetic course or bearing are one and the same thing, but this is the only condition in which they can be the same, in all other cases it would be correct magnetic. To show this more clearly we will work out and state this example in full:

"Magnetic" Bearing of Lighthouse North ... = 0
Var. Ely. (allow to the right to get true bearing) add in this case = 1 pt. R.
—
True Bearing of Lighthouse 1 pt. R of N = N by E.



WESTERLY VARIATION OF THE COMPASS.

Var. Ely. (to the left to get c. m.) .... 1 pt. L.
—
The Correct Magnetic Bearing .... 0 = N.

From the foregoing the student can readily see that the "magnetic" and correct magnetic course or bearing are interchangeable, i. e., one can be changed to the other by applying the variation according to the rules laid down.

Now, we will take the example where the vessel is running by the wind, and the course taken as she steers it, i. e., the course steered being dependent on the direction of the wind.

The "magnetic" course is NE with ½ point Wly. Variation, what is the true course?

Magnetic course..... NE = 4 pts. R of N.
Var. Wly. (to the L) sub. .... ½ pts. L.
—
True course run .... 3½ pts. R of N [= NE½N.

Now, if it were desired to steer a true NE course in the first place (called the course made good) then the example would stand thus:

True course .... NE = 4 pts. R of N.
Var. Wly. (allow to the R sub.) .... ½ pts. R.
Correct magnetic Course .... 4½ pts. R of N = [NE½E.

THE DISTINCTION.

Do you now see the distinction between "magnetic" course and correct magnetic course? If you do, and you had ought to if you have paid strict attention to what has been said, you know a great deal more than many men possessing a navigational education. Some writers use "magnetic" and "correct magnetic" as meaning

one and the same thing under any and all conditions. Little wonder then, that these terms prove such stumbling blocks to the uninformed, and confuse even many thinking men. There is a wide difference in them and each has a distinct meaning of its own, as has already been shown (and to be shown) are properly interchangeable and therefore indefinite.

USE CORRECT MAGNETIC ALTOGETHER.

Note.—It will be well for the student to use correct magnetic course or bearing altogether instead of magnetic course or bearing, and thereby avoid possible confusion, for in the regular run of correcting courses it will be correct magnetic, and as we have seen it cannot be anything else only under certain conditions, which conditions are hardly, if ever, used.

SOME BOOKS MAKE NO DISTINCTION.

Some books use magnetic course or bearing altogether and never even mention correct magnetic course or bearing. They seem to think that it is an advantage to drop the word "correct." As we have learned a magnetic course or bearing is the natural direction of the compass needle when influenced only by the earth's magnetism, and a correct magnetic course is a true course corrected for variation.

THE EXPRESSION ORIGINATED WITH TOWSON.

This very convenient term of "Correct Magnetic" (in place of "Magnetic") was 2introduced by the late Mr. J. T. Towson, an Englishman of acknowledged high authority; and as Captain Lecky says, being concise, and not admitting of ambiguity; it has met with ready acceptance by a large majority of thinking men, but the minority, and some of the loose-jointed, slipshod members of the profession, think the first word unnecessary, and that it would be an advantage to drop it. With this we do not agree. Something therefore is wanted to prevent confusion which must necessarily exist in its use, hence the simple prefix "correct" serves the purpose admirably, and therefore renders clashing impossible. When "magnetic course" is used in place of "correct magnetic" the expression is illogical.

MUST GET A BETTER REASON.

Because the mariner's compass is a magnetic instrument it does not follow that the course steered or the directions shown by it are "magnetic" any more than "correct magnetic," "true" or "compass." Each of these courses have a distinct meaning of their own, and they are widely different from one another, notwithstanding the fact that they all originate and are used in connection with the one instrument. To the uninformed there would seem to be no difference in the expressions "magnetic" course and "compass" course, since both are shown on the one instrument. Of course it must be admitted that since the mariner's compass is a magnetic instrument, that by its aid a magnetic course of some kind could be steered whether correct or incorrect.

ANOTHER ILLUSTRATION OF IT.

Again, supposing the case where the true course is south and the Var. is ½-point Wly.; then magnetic south is ½-point to the left of true south, but the point of the compass coinciding with true south is ½-point to the right of magnetic south, or S½W, which is the correct magnetic point for south (see diagram) therefore to steer true south you would have to steer S½W. If you steered south by compass (the magnetic course) you would be steering S½E true instead of south as your compass shows. By allowing the variation to the true course gives the very same thing, thus ½-point to the right of south gives S½W, the correct magnetic course. But to find the true course after steering south by compass allow the ½-point of Wly. Var. to the left of south, to get the true course run, would be S½E. Thus, in the above case the true course is south; the magnetic course is S½E and the correct magnetic course is S½W. Again, we are brought to a realization of the distinction in the expressions "Magnetic" and "Correct Magnetic." As we said before, in order to avoid confusion it will be well to use correct magnetic altogether instead of magnetic. In fact there can only be a few cases where the magnetic course or bearing is considered.

SOME ILLUSTRATIVE EXAMPLES.

To resume with the conversion of correct magnetic courses to true courses:

If the C. M. C. is W by N, Var. 1 pt. Wly., what is the true course? Ans. West, because Wly. Var. is applied to the left when converting a C. M. C. to a T. C.; therefore 1 pt. to the left of W by N is West.

Supposing the C. M. C. to be N by W with 1 pt. of Ely. Var., what is the corresponding true course? Ans. North.

We will now take some of the examples that we have been working and turn them from correct magnetic to true.

The C. M. C. is N by E¾E, Var. 3¼ points Wly., what is the true course?

C. M. C N by E¾E=	1¾ pts.	R of N
Var. Wly.	3¼ "	L
True Course	1½ "	L of N [=N by W½W.

Here the Var. exceeds the course, so the course is taken from the variation and R changed to L.; 3¼ is the same as 2 5-4, so that 1¾ from 2 5-4 is 1½.

The C. M. C. is NNE, Var. 2 pts. Wly., what is the true course?

C. M. C. NNE=	2 pts.	R of N
Var. Wly.	2 "	L
True Course	0=	North.

The C. M. C. is WSW, Var. 2 pts. Ely., what is the true course?

C. M. C. WSW=	6 R of S
Var. Ely.	2 R
True Course	8 R of S=West.

The C. M. C. is S 56° W, Var. 6° Ely., true course.

C. M.C.=	56° R of S, or SW by W, a
Var. Ely.	6° R [5-pt. co.
T. C.	62° R of S, or SW by W½W

The C. M. C. is N 23° W. Var. 4° Wly., what is the true course?

C. M. C.=	23° L of N
Var. Wly.	4° L
T. C.	27° L of N, or NNW⅜W, nearly.

The correct magnetic course from Chicago to Pt. Betsey is N by E¼E, the mean Var. (what mean Var. is is explained further on) is approximately ¼ pt. Ely., what is the true course between these points? Ans. N by E½E.

The lighthouses on the NWly. and SEly. ends of the Chicago breakwater range NW by W½W (that is the way your compass ought to read when on with this range with no deviation) the Var. being 3° Ely., what is the true bearing of this range? Ans. NW by W¼W.

TURN THE VAR. INTO POINTS.

In practical work it is found more convenient to turn the variation, which is always expressed in degrees, into its equivalent in points, but where greater accuracy is sometimes required the course should also be expressed in degrees and fractions of a degree. Thus, the above example would be as follows:

NW by W½W=	61° 53′ L of N
Var. Ely.	3° R
True bearing	58° 53′ L of N, or NW [by W¼W.

Note.—When there is no variation the true course is also the correct magnetic course and vice versa.

ANOTHER METHOD OF CORRECTING COURSES.

If the student has carefully gone through the preceding examples, he will have noticed that easterly variation in its application from true to correct magnetic courses decreases them in the NE and SW quadrants of the compass, and increases them in the NW and SE quadrants. Westerly variation increases the courses in the NE and SW quadrants,

and decreases them in the NW and SE quadrants.

Thus it is found convenient to employ the plus (+) and minus (—) signs of addition and subtraction when applying the Var. in the conversion of courses or bearings—from true to correct magnetic and the reverse. We, therefore, proceed according to the following:

1. Wly. Var. is + to all points between N and E......S and W.

2. Ely Var. is — from all points between N and E......S and W.

3. Wly. Var. is — from all points between N and W......S and E.

4. Ely. Var. is + to all points between N and W......S and E.

Which may be represented by means of a simple diagram:

	N	
	Ely. Var. + / Wly. Var. —	Ely. Var. — / Wly. Var. +
W		E
	Ely. Var. — / Wly. Var. +	Ely. Var. + / Wly. Var. —
	S	

Bear in mind these rules: When the Var. is additive (+) to the course, if the sum exceeds 90°, subtract it from 180°, and reckon the remainder from N if it had previously been S, but S if it had previously been N.

When the Var. is subtractive (—), and exceeds the quantity from which it is to be taken, subtract the degrees of the course from the Var. and name the remainder from the W if the course had previously been E, but towards the E if it had been W.

Remember that 0° is either north or south as the case may be. And 90° is either E or W.

The following are examples of this method of applying the variation:

The true course is SW½W, Var. 8° Ely, what is the correct magnetic course?

True course SW½W=S 17° W
Var. (sub.) — 8° Ely.

Correct magnetic co. S 9° W=S⅞W, nearly.

Note.—Remember what has been said about discarding minutes and seconds.

The true course is E½N, Var. 1¼ points Wly., what is the correct magnetic course?

True course E½N=N 84° E
Var. (add) + 14° Wly.

N 98° E
180°

Correct Mag. Co. S 82° E=E¾S.

The true course is N 34° W, Var. 7° Wly., what is the corresponding correct magnetic course?

True course N 34° W
Var. — 7° Wly.

C. M. C. N 27° W=NNW⅜W.

The correct magnetic course is N 27° W, Var. 7° Wly., what is the corresponding true course?

Correct magnetic course N 27° W
Variation + 7° Wly.

True Course N 34° W.

The correct magnetic course is SSW ½W, Var. 11° Wly., what is the true course?

Correct magnetic course is SSW½W, Var. 11° Wly., what is the true course?

Correct magnetic course S 28° W
Variation — 11° Wly.

True Course S 17° W=S by W½W.

The correct magnetic course is N½W, Var. 10° Ely., what is the true course?

Correct Magnetic Course N 6° W
Variation — 10° Ely.

True Course N 4° E
Variation — 10° Ely.

Correct Mag. Course N 6° W=N½ W.

SIMPLE RULES TO REMEMBER.

Another good way to remember which way the variation is to be allowed in converting a true course into a correct magnetic course is that Ely. Var. is always added in the 2d and 4th quadrants, and subtracted in the 1st and 3d; and Wly. Var. is always added in the 1st and 3d quadrants and subtracted in the 2d and 4th quadrants.

In converting a correct magnetic course into a true course or bearing Ely. Var. is added in the 1st and 3d quadrants and subtracted in the 2d and 4th quadrants; and Wly. Var. is always added in the 2d and 4th quadrants and subtracted in the 1st and 3d quadrants.

A simple rule to remember for converting a true course into a correct magnetic course is to allow the amount of Wly. Var. away from the true course in the direction that the hands of a watch revolve, and Ely. Var. contrary or against the hands of a watch. To convert a correct magnetic course to a true course the above rule would be the reverse.

GET THE COMPASS CARD DOWN PAT.

Note.—The student should so thoroughly train himself in this kind of work that he can correct a course without so much as even looking at a compass card; that is, he should be able to do it mentally (picture it in the mind and work accordingly.) Some students are able to correct courses mentally much better than writing them out on a slate or paper. The student should first learn to make them readable on paper, and by so doing the mental part of it will come more rapidly with such practice.

BY PORT AND STARBOARD.

Here is another simple rule: From true course to correct magnetic course starboard the helm for Ely. Var., and port the helm for Wly. Var.

From correct magnetic to true, port for Ely and starboard for Wly.; or the reverse of the above.

THE MAGNETIC POLE.

The magnetic pole is not identical with the true pole of the earth, and, since the needle is drawn to the magnetic pole, the line of its direction varies from the direction of the true meridian; the angles which measures this difference of direction is called the variation of the compass, or magnetic variation. The former is the better term and conveys the right idea of what the compass ought to do.

THE VARIATION VARIES.

The variation is different in different places, and at any fixed place it is undergoing a gradual periodic change, besides having a small diurnal fluctuation. The latter influence of the magnetic needle, though of interest to scientists, for the sailor it has no real significance. Charts are now constructed upon which are drawn the lines of equal variation, or isogonic lines, to assist the navigator in separating the deviation from the variation and vice versa. See any of the lake survey charts (of late issue) for the variation compass, or magnetic compass rose, which are always printed inside of the true compass rose.

INCOMPLETE WITHOUT A VARIATION CHART OF THE LAKES.

The student should provide himself with a set of these charts for the chain of lakes, and he should study all the information of this nature contained on them; such as the table of compass variations, showing the date and its amount when first observed; what the variation is to date, that is, the date of issue of the chart, showing the annual change and other data of value and interest. To get the average annual change in variation, find its difference for a number of years as given on the chart, and divide this difference by the number of years separated between the dates used, or as follows: Var. at Sault Ste. Marie in 1895 was 2° 16.5′ Wly.; in 1902 it was 2° 57′ Wly. Difference in years, 7; difference in variation for 7 years 4.05′; one year 5.8′, nearly.

TO CORRECT FOR ANNUAL CHANGE.

To correct the variation for annual change, in order to compute it for a given year, multiply the annual change by the number of years that have elapsed since the chart was corrected. Remember, that easterly variation is

decreasing and westerly is increasing; therefore, when correcting easterly variation substract the annual change, and for westerly add it to the Var. given. For example: Var. at Buffalo in 1902, 6° 06' Wly, increasing 4' annually, what will the Var. be in 1910, or 8 years later? 4' × 8 = 32' +6° 06' = 6° 38'.

If the annual change in the Var. is 5' how many years will it take to effect the Var. 1°? Ans. 12 years.

These matters will be more fully explained in another chapter.

The student should also provide himself with a variation chart of the lakes showing the isogonic curves. On account of the constant changes the government makes new engravings about every five years. These charts can be procured from the U. S. Coast Geodetic Survey, Treasury Dept., Washington, D. C.

TO ALLOW FOR VARIATION BETWEEN DEPARTURE AND DESTINATION.

To find the variation (called the mean, or average variation) between a point of departure and a point of destination, in order to steer one course throughout, add the two (ends) variations together if they have the same name that is, both easterly, or both westerly, and find the mean variation by dividing the sum of the variations by 2. This quotient will be the proportional variation to be applied to the true course between the two points; that is, this will equal the average amount of the variation all along the route. For example: The Var. at departure is 6° Wly. and at destination 2° Wly. The two equal 8°, half of which is 4° = ⅜ point. Now, if at departure the 6° was allowed it would be altogether too much as the destination was neared. If the variation at destination—2° were used it would not be correct for the amount at departure. Now, the 4° allowed all the way through averages it up; that is, it would not be enough at departure, but as the port of departure was neared and the variation decreased, it would bring us on the right course at the finish. The vessel's track would actually be a curve instead of a straight line and she would not be on the straight line course until the end of it was reached.

THE MEAN VARIATION.

Var. at Chicago ..3° Ely.
Var. at Pt. Betsey.1½° Ely.

2)4½°

Mean Var. to be
applied ....2¼° Ely = ¼-point.

The true course from Chicago to Pt. Petsey is N by E½E, and ¼-point of Ely variation makes the correct magnetic course N by E¼E, the course to be steered provided there was no deviation on this point of the compass.

The true course from Chicago to the door is N¾E, and the correct magnetic course is N½E. The variation at Chicago is 3° Ely. and at the door 1¾° Ely.

From North Manitou island to Waugoshance there is practically no variation, hence the true course is also the correct magnetic course, and if there were no deviation the chart course could be steered.

From White Shoal lightship to Old Mackinaw Pt. the true course is E½S, variation practically nothing. At Old Mackinaw the variation is 1¾° Wly, one-half (the mean) of which equals 53', or nearly 1°. We make no allowance in a case of this kind (where the variation is so small), since the effects of the variation if not allowed for, would carry the vessel to the left (off-shore in this case) of the course and on the safe side. Under the same conditions if the variation were easterly instead of westerly, it would be good judgment to apply the variation to the true course—if steering to degrees call the 53' 1°, but if steering to fractional points call it ⅛-point. The difference lies on the safe side. All these matters will be explained in detail in the chapter on "Shaping the Course."

The above method of applying the variation may be used where there is ample room, but on long routes where the variation changes rapidly, to apply a single correct magnetic course to be steered all along the line, might lead to dangerous results. Long, straight, routes should be subdivided into parts and the correct magnetic course given for each part.

However, on most lake routes it is practicable to take the mean of the two variations, that is, the variation at the ends of the course. Remarks:—If the variation at departure were westerly and easterly at destination what would that indicate? It would indicate that in order to reach your point of destination you will have to cross the line of no variation. In case of this kind just take one-half of the variation at the departure and apply it to the true course and this will give the proportional variation between the starting point and the line of no variation. When you have crossed the line of no variation take one-half of the variation at destination and apply it to your true course. For example:

CROSSING THE LINE OF NO VARIATION.

The true course from Whitefish Pt. to Copper Harbor is WNW⅛W. The line of no variation crosses this course at a point some 47 miles from Whitefish Pt. The variation at Whitefish Pt. is 2° 25' Wly., the mean, or one-half of which, is 1° 12' = ⅛ point, nearly; making the correct magnetic course WNW (⅛ point Wly. allow to the right) to the line of no variation. From the line of no variation to Copper Harbor the true course is again WNW⅛W. Variation at Copper Harbor is 2° 13' Ely. one-half of which is 1° 7' equals ⅛-point, nearly, making the correct magnetic course WNW¼W (Ely. Var. to the left.) In other words, for the first 47 miles the correct magnetic course is WNW and for the balance of the way it is WNW¼W. Hence it is a difficult matter to make one course of this stretch, though so often tried.

The true course from Devils Island to Duluth is W S W¼W. Var. at Devils Island about 6° Ely, and at Duluth 8° 15' Ely, the mean, of which is 7° 8' = ⅝ point. This applied to the true course gives the correct magnetic course SW by W⅝W.

There are many lake captains who pay no attention to the variation at all, thinking it unnecessary on account of it amounting to little or nothing. On Lake Superior their wrong steering is laid to local attraction, when in fact, in nine cases out of ten, it is the variation.

SOME EXAMPLES FOR PRACTICE.

The true course from Erie to Buffalo is NE½E; Var. at Erie 4° 14' Wly., and at Buffalo 6° 1' Wly., what is the correct magnetic course between these ports? Answer NE by E.

The true course from Milwaukee to the door is N by E½E, variation at Milwaukee 3° 30' Ely., at the door 1° 50' Ely., what is the correct magnetic course? Answer, N by E¼E, same as Chicago to Pt. Betsey.

The true course from Thunder Bay island to Port Sanilac is S by E⅝E, variation at Thunder Bay 4° 27' Wly., at Port Sanilac 3° 43' Wly., what is the correct magnetic course? Answer S by E¼E.

QUESTIONS FOR WHEELSMEN AND WATCHMEN.—NO. 24.

241. When bound up, what land mark would you use for a turning point at the intersection of lower and upper St. Mary's river ranges?

242. What mark would you use for a turning point at the intersection of upper St. Mary's river and Bernard ranges?

243. What is the true bearing of St. Mary's river lower ranges?

244. What is the correct magnetic bearing of St. Mary's river upper ranges?

245. What is the true bearing of Bernard ranges?

246. Bound up and having stern of your boat on Bernard ranges your steering compass reads NW⅞N, how would you steer with same compass and boat in same trim to a point one mile north of White Fish point lighthouse?

247. Bound down and heading on Bernard ranges, what turning mark would you use to bring head of your boat on St. Mary's river upper ranges?

248. Bound down and heading on St. Mary's river lower ranges, what turning mark would you use to haul around Point Au Pins?

249. Bound down Soo river with stern of your boat on Point Au Pins ranges your compass reads NExE, how would you steer with same compass and boat in same trim from Duluth harbor entrance to a point two miles NxW½W from Devil island lighthouse?

250. Explain how you would come to an anchor to the south of Point Iroquois shoals with a deep-loaded vessel after running back from White Fish Point to secure shelter from a NE gale.

QUESTIONS FOR OILERS AND WATERTENDERS.—NO. 19.

180. What would be the contents of a bunker in square feet, height of which is 25 ft. amidship, length fore and aft 12 ft., width or beam of ship at top 50 ft., at bottom 24 ft., a line drawn athwartship halfway to the top being 35 ft?

181. What proportion does the area of the steam pipe bear to that of the cylinder, if the diameter of pipe is seven inches and the cylinder 35 in.?

182. An engine that indicates 400 H. P. uses 21 lbs. weight of steam per horsepower per hour, the boiler is 16 ft. by 14 ft. at the water level—the glass indicates six inches of water, how long will it be before the water will be out of the glass?

183. Supposing you have 149 gallons of oil to run down, you have a circular tank 37 in. diameter and three inches high, will it hold same?

184. There are 185 sq. ft. of flat surface to be stayed the pressure of steam to be carried is 80 lbs. per square inch. There are seven rows of stays 10 stays in a row allowing 6,000 lbs. per square inch section of stay, what will the diameter of stay be?

185. What is meant by circulation in a boiler and what are the results of defective circulation?

186. What is the measure of a horsepower? How is indicated horsepower ascertained?

187. What is back pressure in a cylinder, and how much is generally used in the high and low-pressure cylinders?

188. What is meant by "speed of piston?" About how much is the speed in the modern marine engine?

189. What is meant by "cutting off steam?" Describe a riding cut-off valve."

QUESTIONS FOR MASTERS AND MATES.—NO. 23.

340. If your boat burns 1.8 lbs. of coal per indicated horsepower, and consumes 1,500 lbs. per hour, what is the indicated horsepower of engines?

341. If 1,500 lbs. of coal per hour be required for a speed of 12 miles in a moderate breeze and smooth sea, how much is required for a speed of nine miles under the same conditions?

(Note.—The rule is that the indicated horsepower (or coal consumption) varies with the cube of the speed of the engines.)

342. What is a Mercator projection?

343. Is the rhumb or straight line course on a Mercator chart straight on the earth's surface?

344. How does it differ from the actual conditions?

345. What is the shortest distance between two places on the earth's surface?

346. What is the shortest distance between two points on a plane surface?

347. Do you have to change the rhumb course in order to sail between any two points on the earth's surface?

348. How is it possible by steering the self-same course to go from place to place what lie on the arc of a great circle from each other?

349. Which is the shorter the rhumb course or the great circle track?

350. Why is it necessary to keep changing the great circle course?

351. Is the great circle track of any advantage in lake navigation?

352. Why not?

353. About how much distance is saved between New York and Liverpool in using the great circle course instead of the rhumb course?

354. A steamer is supplied with fuel sufficient for 2,000 miles at a speed of 12 miles, at what reduced speed must she steam to cover 3,000 miles?

(Rule.—Multiply the original distance by the square of the original speed, and divide by the new distance. The square root of the product will be the required speed.)

SHIP BUILDING AT BALTIMORE.

Baltimore, Md., Dec. 12.—Work in the local ship yards is now somewhat slack though the placing of orders for three tugs by the Standard Oil Co. with the Skinner Ship Building & Dry Dock Co. is looked upon as a good omen and that there will be many more orders find their way here during the next few weeks.

McIntyre & Henderson are now getting out the material for a steel tug that will be 105 ft. long and it is understood that it is for a local firm.

Thomas McCosker & Sons have Standard Oil barge No. 77 on their dock for overhauling.

At Beacham's yard the United States survey steamer Bache is on the railway for overhauling by McIntyre & Henderson who have the general contract.

Booz Bros. have the contract for repairing lightship No. 80 but the job is a small one.

W. E. Woodall & Co. have in dock the schooner Stillman F. Kelly, of Thomaston, Me., for caulking all over.

The Spedden Ship Building Co. has been awarded the contract for repairs to Lightship No. 7, their bid being $1,215.25. Booz Bros. bid $1,415 and the Marine Railway, Machine & Boiler Works, $1,835.

John Flusky is making repairs to the Degnon Contracting Co.'s dredge Edward S. Walsh.

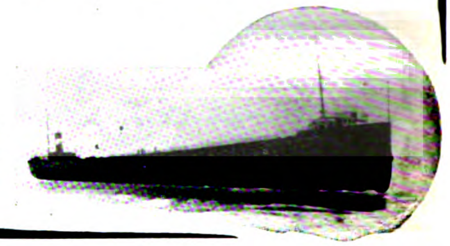
Oliver Reeder & Son launched a 29-foot harbor lighter for M. W. Adams and laid the keel for a duplicate.

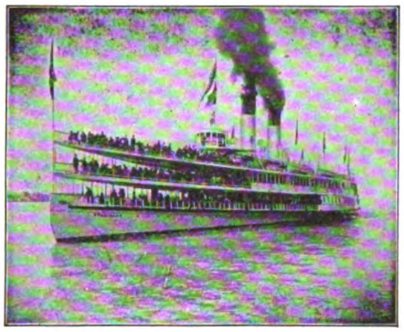
BIG TUGS FOR COAST TOWING.

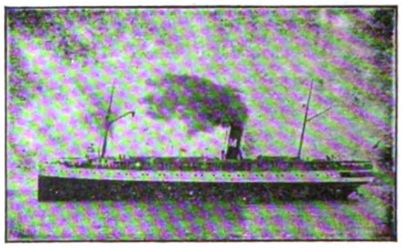
The Shipmen's & Merchants' Tugboat Co., of San Francisco, are having built at Camden, N. J., two tow boats which will be the largest and most up-to-date vessels of the class on the Pacific Coast. The work was begun on one of the boats about six weeks ago, and now the frame is well under way, while the keel for the second boat was very recently laid. Both will be completed by the first of next May, and will come out to San Francisco together. They are to be used in general coast towing. The new tugs will each have a length of 150 ft., 27 ft. beam, and 17 ft. depth of hold. The engines will be triple expansion using oil as fuel.

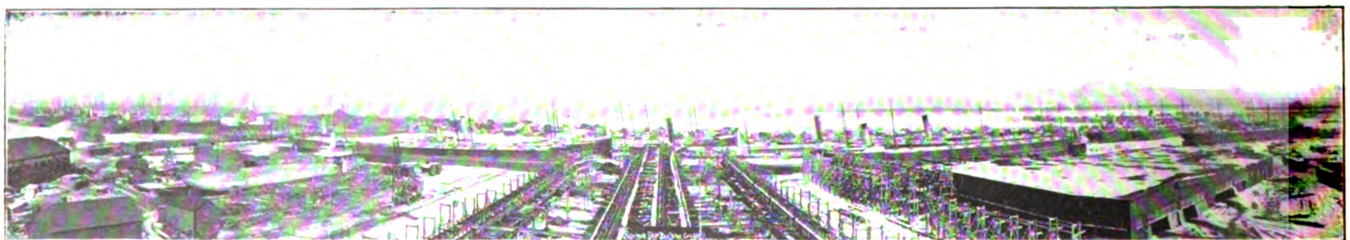
THE MARINE REVIEW

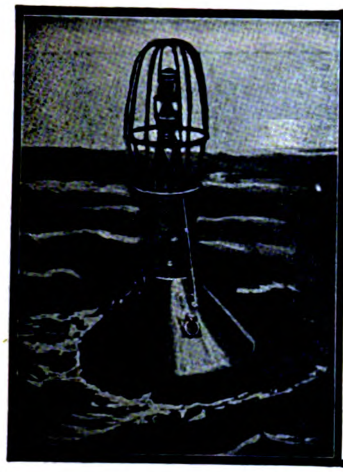
VOL. XXXIV. CLEVELAND, DECEMBER 20, 1906. No. 25.











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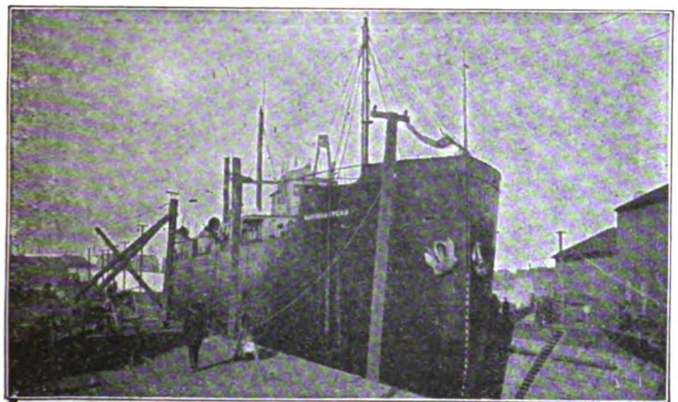

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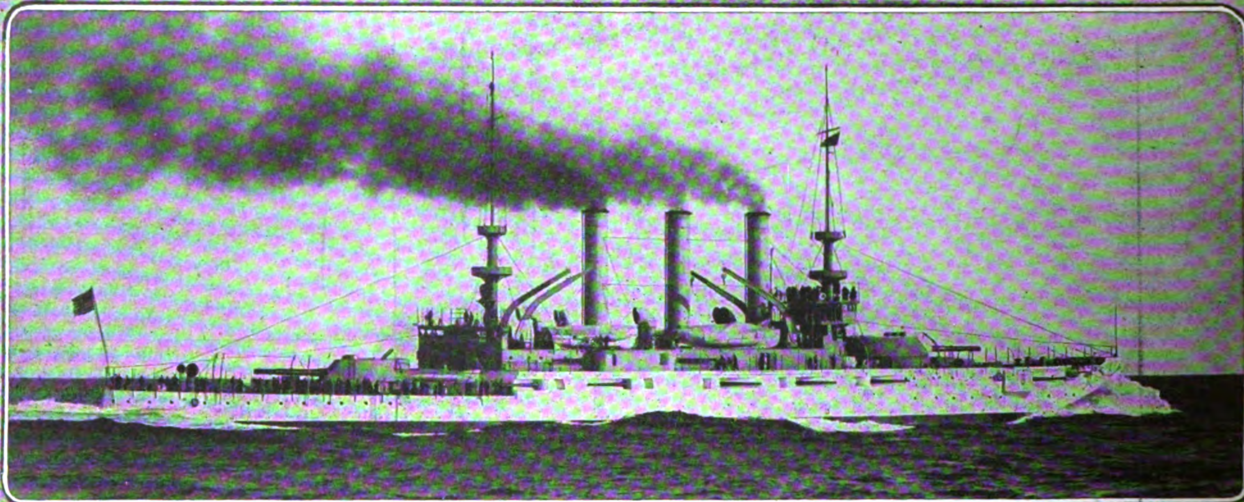


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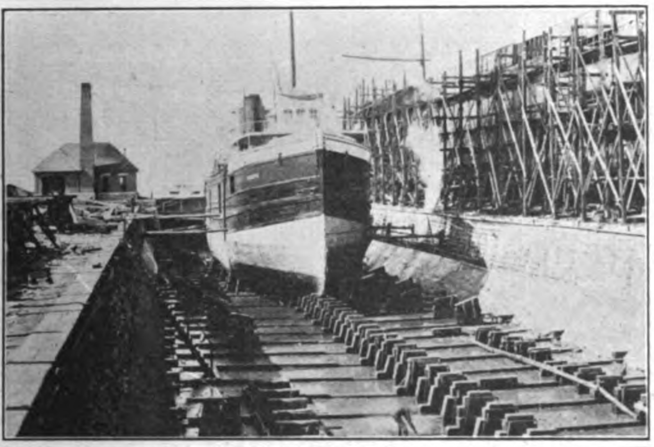

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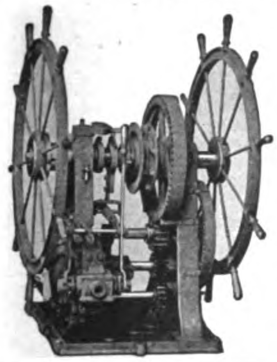

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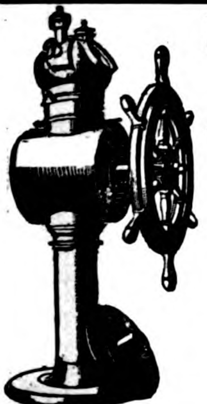

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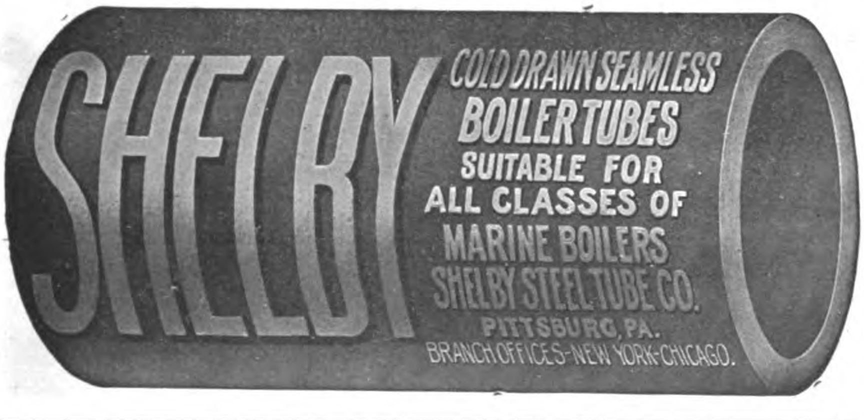

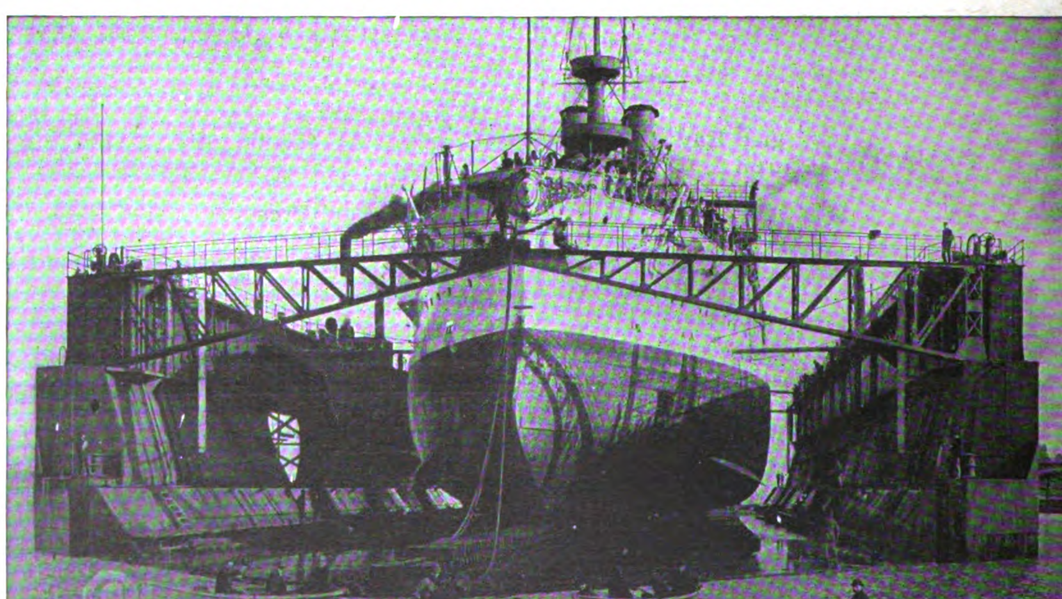

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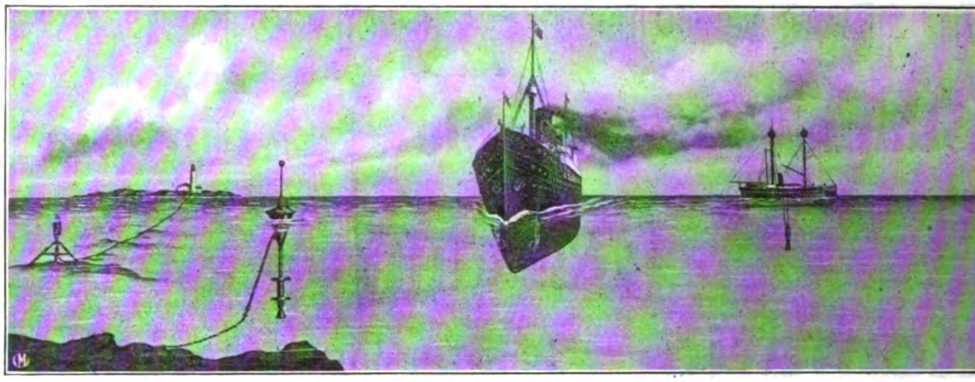

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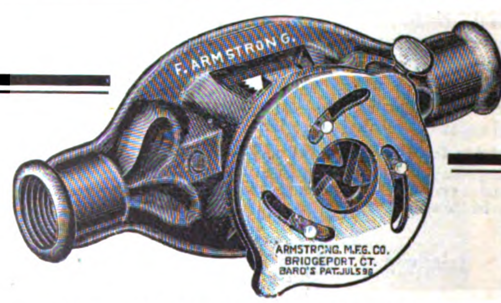

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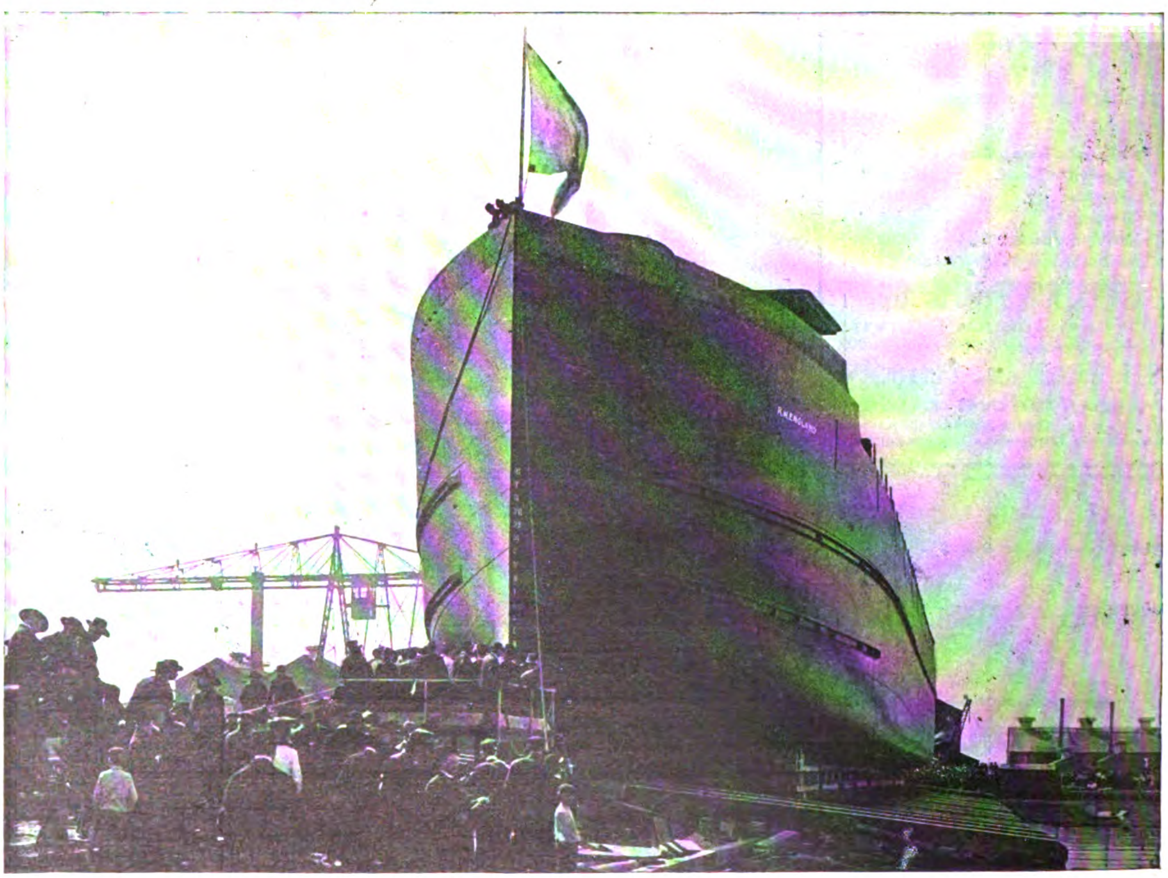

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For a more complete classification than that represented by advertisers in The Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, Marine and Naval Directory of the United States, published by The Marine Review, Cleveland.

[See accompanying Index of Advertisers for full addresses of concerns in this Directory.]

AIR COMPRESSION, HOISTS.
Great Lakes Engineering Works.... .... Detroit.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co......... .... New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co...... .... Quincy, Mass.
Great Lakes Engineering Works.... .... Detroit.

ANCHORS.
Bowers, L. M. & Co................. ....Binghamton, N. Y.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons....Philadelphia.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co........ .... Cleveland.
Detroit Ship Building Co....Detroit.
Great Lakes Engineering Works.... .... Detroit.

ASH EJECTORS.
Great Lakes Engineering Works.... .... Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Gilchrist, Albert J........Cleveland.
Goulder, Holding & Masten........ .... Cleveland.
Hoyt, Dustin & Kelley....Cleveland.
Jenkins, Russell & Eichelberger.... ....Cleveland.
Kremer, C. E. ....Chicago.
MacDonald, Ray G..........Chicago.
Maytham, Frank.............Buffalo
Shaw, Warren, Cady & Oakes...... .... Detroit.
White, Johnson, McCaslin & Cannon ....Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons............... ....Brookline, Mass.

BENDING MACHINES
Cleveland Punch & Shear Works Co. .... Cleveland.

BLOCKS, SHEAVES, ETC.
Boston Lockport Block Co........ ....Boston, Mass.

BLOWERS.
American Blower Co., Detroit, Mich.

BOAT BUILDERS.
Drein, Thos. & Son................ ....Wilmington, Del.
Kahnweiler's Sons, David.......... ....New York.
Truscott Boat Mfg. Co............. ....St. Joseph, Mich.

BOILER COMPOUNDS.
Dearborn Drug & Chemical Works.. ....Chicago.
State Manufacturing Co...Cleveland.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co........ ....Providence, R. I.
American Ship Building Co......... .... Cleveland.
Atlantic Works..East Boston, Mass.
Briggs, Marvin..........New York.
Chicago Ship Building Co..Chicago.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fletcher, W. A. & Co............. ....Hoboken, N. J.
Fore River Shipbuilding Co........ ....Quincy, Mass.
Great Lakes Engineering Works.... .... Detroit.
Kingston Foundry & Machine Works ....Oswego, N. Y.
Lake Erie Boiler Wks.......Buffalo
Maryland Steel Co................. ....Sparrow's Point, Md.
McLaughlin Iron Wks ..Ashtabula, O.
Milwaukee Dry Dock Co.......... ....Milwaukee.
Mosher Water Tube Co..New York.
Newport News Ship Building Co.. ....Newport News, Va.
New York Shipbuilding Co.......... .... Camden, N. J.
Northwestern Steam Boiler & Mfg. Co.............Duluth, Minn.
Ohio Machine & Boiler Co......... .... Cleveland.
Quintard Iron Works Co.......... ....New York.
Roberts Safety Water Tube Boiler Co. ....New York.
Superior Ship Building Co........ .... Superior, Wis.
Taylor Water Tube Boiler Co.... .... Detroit.
Toledo Ship Building Co.......Toledo.

BOILER RIVETS.
Bourne-Fuller Co.........Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.......... ....Cuyahoga Falls, O.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons.....Philadelphia.
Fore River Ship & Engine Co...... ....Quincy, Mass.
Great Lakes Engineering Works.. .... Detroit.
Lunkenheimer Co........Cincinnati.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co.... ....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co.............. Cleveland.
G. H. Williams Co........Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co........Cleveland.

CANVAS SPECIALTIES.
Baker & Co., H. H.........Buffalo.
Bunker, E. A...........New York.
Upson-Walton Co.........Cleveland.

CAPSTANS.
American Ship Windlass Co........ .... Providence, R. I.
Dake Engine Co.................... ....Grand Haven, Mich.
Hyde Windlass Co........Bath, Me.
Marine Mfg. & Supply Co.......... ....New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co................ ....Jersey City, N. J.

CHAIN SURVEYORS, HOISTS.
Brown-Hoisting Machinery Co...... ....Cleveland.
General Electric Co................ ....Schenectady, N. Y.

CHAIN HOISTS.
Boston & Lockport Block Co...... .... Boston, Mass.

CHARTS.
Penton Publishing Co....Cleveland.

CHECK VALVES.
Scoville Check Valve Co., Ashtabula, O.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ritchie, E. S. & Sons............. .... Brookline, Mass.

CLOTHING, WATERPROOF.
Armstrong, E. A. Mfg. Co...Chicago.

COAL PRODUCERS AND SHIPPERS.
Hanna, M. A. & Co........Cleveland.
Pickands, Mather & Co....Cleveland.
Pittsburg Coal Co........Cleveland

COAL AND ORE HANDLING MACHINERY.
Brown-Hoisting Machinery Co...... ....Cleveland.

COMPASSES.
Ritchie, E. S. & Son............... .... Brookline, Mass.

CONDENSERS.
Great Lakes Engineering Works.... .... Detroit.
Wheeler Condenser & Engineering Co.................... New York.

CONTRACTORS FOR PUBLIC WORKS.
Breymann Bros., G. H.......Toledo.
Buffalo Dredging Co........Buffalo.
Dunbar & Sullivan Dredging Co.... ....Buffalo.
Great Lakes Dredge & Dock Co.... .... Chicago.
Hickler Bros......... ....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich
Starke Dredge & Dock Co., C. H... .... Milwaukee.
Standard Contracting Co..Cleveland.
Sullivan, M................ Detroit

CORDAGE.
Baker & Co., H. H..........Buffalo.
Upson-Walton Co........Cleveland.

Buyers' Directory of the Marine Trade.—*Continued.*

CORK JACKETS AND RINGS.
Armstrong Cork Co..Pittsburg, Pa.
Kahnweiler's Sons, D....New York.

CRANES, TRAVELING.
Brown-Hoisting Machinery Co...... .... Cleveland.

CUTTING OFF MACHINES.
Cleveland Punch & Shear Works Co. .... Cleveland.

DIVING APPARATUS.
Morse, A. J. & Son........Boston.
Schrader's Son, Inc., A..New York.

DREDGING CONTRACTORS.
Breymann & Bros., G. H....Toledo.
Buffalo Dredging Co........Buffalo.
Dunbar & Sullivan Dredging Co.... .... Buffalo.
Great Lakes Dredge & Dock Co.. .... Chicago.
Hickler Bros. ....Sault Ste. Marie, Mich.
Hubbell Co., H. W..Saginaw, Mich.
Starke Dredge & Dock Co., C. H... ....Milwaukee.
Sullivan, M.................Buffalo.

DREDGING MACHINERY.
Quintard Iron Works Co.New York.
Superior Iron Works...Superior, Wis.

DRILLING MACHINES.
Cleveland Punch & Shear Works Co. .... Cleveland.

DRY DOCKS.
American Ship Building Co........ .... Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co......Buffalo.
Chicago Ship Building Co.......... .... Chicago.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co.......... .... Detroit
Great Lakes Engineering Works.... .... Detroit.
Lockwood Mfg. Co................. ....East Boston, Mass.
Milwaukee Dry Dock Co............ ....Milwaukee.
Newport News Ship Building Co... ....Newport News, Va.
Superior Ship Building Co........ .... Superior, Wis.
Tietjen & Lang Dry Dock Co...... .... Hoboken, N. J.
Toledo Ship Building Co......Toledo.

DYNAMOS.
General Electric Co................ ....Schenectady, N. Y.

ELECTRIC HOISTS AND CRANES.
General Electric Co................ ....Schenectady, N. Y.

ELECTRIC LIGHT AND POWER PLANTS.
General Electric Co................. ....Schenectady, N. Y.

ENGINE BUILDERS, MARINE.
American Blower Co., Detroit, Mich.
American Ship Building Co......... .... Cleveland.
Atlantic Works, East Boston, Mass.
Briggs, Marvin..........New York.
Chicago Ship Building Co., Chicago.
Chase Machine Co........Cleveland.
Cramp, Wm. & Sons, Philadelphia.
Detroit Ship Building Co., Detroit.
Fletcher, W. & A. Co., Hoboken, N. J.
Fore River Shipbuilding Co......... .... Quincy, Mass.
Great Lakes Engineering Works.... .... Detroit, Mich.
Hall Bros. .... Philadelphia.

ENGINE BUILDERS—Continued.
Lockwood Mfg. Co................ ....East Boston, Mass.
Maryland Steel Co................. ....Sparrows Point, Md.
Milwaukee Dry Dock Co., Milwaukee.
Mosher, Chas. D.........New York.
Newport News Ship Building Co.... ....Newport News, Va.
New York Ship Building Co........ ....Camden, N. J.
Northwestern Steam Boiler & Mfg. Co. .... Duluth, Mich.
Quintard Iron Works Co., New York.
Roach's Ship Yard......Chester, Pa.
Sheriffs Mfg. Co.........Milwaukee.
Superior Ship Building Co.......... .... Superior, Wis.
Toledo Ship Building Co......Toledo.
Trout, H. G.................Buffalo.

ENGINE ROOM TELEGRAPH CALL BELLS, ETC.
Cory, Chas. & Son......New York.
Marine Mfg. Supply Co., New York.

ENGINEERING SPECIALTIES AND SUPPLIES.
Lunkenheimer Co. ...... Cincinnati.
Northwestern Steam Boiler & Mfg. Co. .... Duluth, Minn.

ENGINEERS, MARINE, MECHANICAL, CONSULTING.
Furstenau, M. C......... Philadelphia.
Hynd, Alexander .... Cleveland.
Hunt, Robt. W. & Co......Chicago.
Kidd, Joseph..........Duluth, Minn.
Mosher, Chas. D........New York.
Nacey, James .... Cleveland.
Roelker, H. B............New York.
Wood, W. J.................Chicago.

FANS.
American Blower Co., Detroit, Mich.

FEED WATER PURIFIERS AND HEATERS.
Ross Valve Co..........Troy, N. Y.
Wheeler Condenser & Engineering Co. .... New York.

FIXTURES FOR LAMPS, OIL OR ELECTRIC.
General Electric Co................. ....Schenectady, N. Y.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.
Cleveland City Forge & Iron Co.... .... Cleveland.
Fore River Shipbuilding Co......... .... Quincy, Mass.
Ohio Machine & Boiler Co......... .... Cleveland.

FLUE WELDING.
Fix's S. Sons............Cleveland.

FUELING COMPANIES AND COAL DEALERS.
Hanna, M. A. & Co......Cleveland.
Parker Bros. Co., Ltd......Detroit.
Pickands, Mather & Co., Cleveland.
Pittsburg Coal Co........Cleveland.
Smith, Stanley B., & Co., Detroit.
Toledo Fuel Company, ...Toledo, O.

FURNACES FOR BOILERS.
Continental Iron Works, New York.

GAS BUOYS.
Safety Car Heating & Lighting Co.. .... New York.

GAS AND GASOLINE ENGINES.
Chase Machine Co........Cleveland.

GAUGES, STEAM AND VACUUM.
Lunkenheimer Co. ...... Cincinnati.

GAUGES, WATER.
Lunkenheimer Co......Cincinnati, O.

GENERATING SETS.
General Electric Co................ ....Schenectady, N. Y.

GRAPHITE.
Dixon Crucible Co., Joseph.......... ....Jersey City, N. J.

HAMMERS, STEAM.
Chase Machine Co........Cleveland.
Cleveland Punch & Shear Works Co. .... Cleveland.

HEATING AND VENTILATING APPARATUS.
American Blower Co., Detroit, Mich.

HOISTS FOR CARGO, ETC.
American Ship Building Co.......... .... Cleveland.
Brown Hoisting Machinery Co...... .... Cleveland.
Chase Machine Co.......Cleveland.
Dake Engine Co.................... ....Grand Haven, Mich.
General Electric Co......New York.
Hyde Windlass Co........Bath, Me.
Marine Iron Co............Bay City.

HOLLOW STAYBOLT IRON.
Falls Hollow Staybolt Co.......... ....Cuyahoga Falls, O.

HYDRAULIC DREDGES.
Great Lakes Engineering Works.... .... Detroit.

HYDRAULIC TOOLS.
Watson-Stillman Co., The......... .... New York.

ICE MACHINERY.
Great Lakes Engineering Works.... .... Detroit.
Roelker, H. B...........New York.

INJECTORS.
American Injector Co......Detroit.
Jenkins Bros.............New York.
Lunkenheimer Co. ...... Cincinnati.
Penberthy Injector Co............. .... Detroit, Mich.

INSURANCE, MARINE.
Atlantic Mutual Insurance Co........ ....New York.
Belcher, Fred P...........Winnipeg.
Elphicke, C. W. & Co......Chicago.
Gilchrist & Co., C. P.....Cleveland.
Hawgood & Co., W. A., Cleveland.
Helm & Co., D. T..........Duluth.
Hutchinson & Co.........Cleveland.
McCarthy, T. R...........Montreal.
McCurdy, Geo. L...........Chicago.
Mitchell & Co............Cleveland.
Parker Bros. Co., Ltd......Detroit.
Peck, Chas. E. & W. F............ ....New York and Chicago.
Prindiville & Co...........Chicago.
Richardson, W. C........Cleveland.
Sullivan, D. & Co..........Chicago.
Vance & Joys Co..........Milwaukee.

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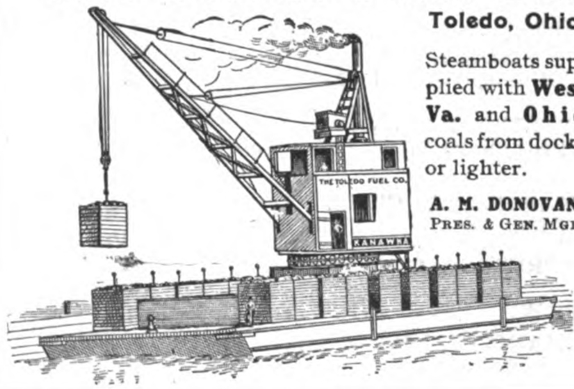

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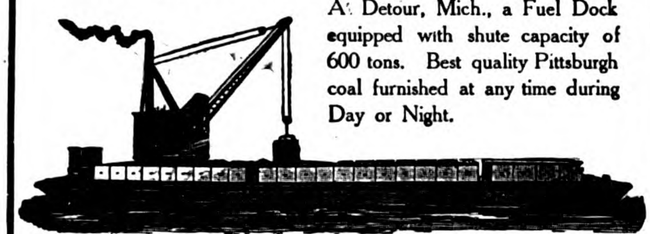

Western Reserve Building, CLEVELAND, O.

Buyers' Directory of the Marine Trade---*Continued.*

IRON ORE AND PIG IRON.
Bourne-Fuller Co......Cleveland, O.
Hanna, M. A. & Co........Cleveland.
Pickands, Mather & Co., Cleveland.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.
Truscott Boat Mfg. Co..................St. Joseph, Mich.

LIFE PRESERVERS, LIFE BOATS, BUOYS.
Armstrong Cork Co......Pittsburg.
Carley Life Float Co..................New York, N. Y.
Drein, Thos. & Son................ Wilmington, Del.
Kahnweiler's Sons, D.....New York.

LOGS.
Nicholson Ship Log Co., Cleveland.
Walker & Sons, Thomas................ Birmingham, Eng.

LUBRICATING GRAPHITE.
Dixon Crucible Co., Joseph................Jersey City, N. J.

LUBRICATORS.
Lunkenheimer Co. ...... Cincinnati.

LUMBER.
Martin-Barriss Co. ...... Cleveland.

MACHINISTS.
Chase Machine Co........Cleveland.
Hickler Bros., Sault Ste. Marie, Mich.
Lockwood Mfg. Co...............East Boston, Mass.
McLaughlin Iron Works, Ashtabula, O.
Ohio Machine & Boiler Co..................... Cleveland.
Superior Iron Works.Superior, Wis.

MACHINE TOOLS (WOOD WORKING).
Atlantic Works, Inc....Philadelphia

MARINE RAILWAYS
Hickler Bros., Sault Ste. Marie, Mich.

MARINE TORCHES.
Marine Torch Co..........Baltimore.

MATTRESSES, CUSHIONS, BEDDING.
Fogg, M. W..............New York

MECHANICAL DRAFT FOR BOILERS.
American Blower Co., ...Detroit.
American Ship Building Co....................... Cleveland.
Detroit Ship Building Co., Detroit.
Great Lakes Engineering Works......................... Detroit.

METALLIC PACKING.
Katzenstein, L. & Co., New York.

MOTORS, GENERATORS—ELECTRIC.
General Electric Co................Schenectady, N. Y.

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons................. Brookline, Mass.

NAVAL ARCHITECTS.
Curr, Robert ....Cleveland
Hynd, Alexander ....Cleveland
Kidd, Joseph ....Duluth, Minn.
Mosher, Chas. D.........New York.
Nacey, James ....Cleveland
Wood, W. J...............Chicago

OAKUM.
Stratford, Oakum Co.................Jersey City, N. J.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph................Jersey City, N. J.

PACKING.
Jenkins Bros............New York.
Katzenstein, L. & Co...New York.

PAINTS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co........Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc. ..Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co........Buffalo.
Dunbar & Sullivan Dredging Co.... Buffalo.
Great Lakes Dredge & Dock Co.... Chicago.
Hickler Bros..Sault Ste. Marie, Mich.
Hubbell Co., H. W...Saginaw, Mich.
Parker Bros. Co., Ltd.......Detroit.
Starke Dredge & Dock Co., C. H...Milwaukee.
Sullivan, M.................Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co......Cleveland, O.

PLANERS.
Cleveland Punch & Shear Works Co. .... Cleveland.

PLANING MILL MACHINERY.
Atlantic Works, Inc....Philadelphia.
Cleveland Punch & Shear Works Co. .... Cleveland.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co......Cleveland, O.
Otis Steel Co............Cleveland.

PRESSURE REGULATORS.
Ross Valve Co..........Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co....................... Cleveland.
Atlantic Works ..East Boston, Mass.
Cramp, Wm. & Sons..Philadelphia.
Detroit Ship Building Co....Detroit.
Fore River Shipbuilding Co.................. Quincy, Mass.
Great Lakes Engineering Works.... Detroit.
Hyde Windlass Co........Bath, Me.
Lockwood Mfg. Co..............East Boston, Mass.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co..............Newport News, Va.
Roelker, H. B..........New York.
Sheriffs Mfg. Co.......Milwaukee.
Superior Ship Building Co...................Superior. Wis.
Toledo Ship Building Co......Toledo.
Trout, H. G................Buffalo.

PROJECTORS, ELECTRIC.
General Electric Co..............Schenectady, N. Y

PUNCHES AND SHEARS.
Cleveland Punch & Shear Works Co. .... Cleveland.

PUMPS FOR VARIOUS PURPOSES.
Great Lakes Engineering Works.. Detroit.
Kingsford Foundry & Machine Works ....Oswego, N. Y.
Wheeler Condenser & Engineering Co. ....New York.
Roelker, H. B..........New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register......Cleveland.

RIVETS, STEEL FOR SHIPS AND BOILERS.
Bourne-Fuller Co.......Cleveland, O.
Great Lakes Engineering Works.... Detroit.

SAFETY VALVES.
Lunkenheimer Co.........Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co....Buffalo.
Upson-Walton Co........Cleveland.

SALVAGE COMPANIES.
See Wrecking Companies.

SEARCH LIGHTS.
General Electric Co...............Schenectady, N. Y.

SHEARS.
See Punches, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne-Fuller Co......Cleveland, O.
Otis Steel Co............Cleveland.

SHIP BUILDERS.
American Ship Building Co......... Cleveland.
Atlantic Works ..East Boston, Mass.
Buffalo Dry Dock Co.......Buffalo.
Collingwood Shipbuilding Co.,.............. Collingwood, Ont.
Cramp, Wm. & Sons..Philadelphia
Chicago Ship Building Co..Chicago.
Detroit Ship Building Co....Detroit.
Fore River Ship Building Co...................Quincy, Mass
Great Lakes Engineering Works....Detroit.
Lockwood Mfg. Co..............East Boston, Mass.
Maryland Steel Co.............Sparrow's Point, Md.
Milwaukee Dry Dock Co........... Milwaukee.
Newport News Ship Building Co...............Newport News, Va.
New York Shipbuilding Co....................Camden, N. J.
Roach's Ship Yard.....Chester, Pa.
Toledo Ship Building Co......Toledo.

SHIP CHANDLERS.
Baker, Howard H. & Co....Buffalo.
Marine Mfg. & Supply Co........ New York
Upson-Walton Co........Cleveland.

SHIP DESIGNERS.
Kidd, Joseph ....Duluth.
Steel, Nacey, & Hynd....Cleveland.
Wood, W. J...............Chicago.

SHIP FLOORING.
Clemente, The C., Co....Cleveland.

Buyers' Directory of the Marine Trade---*Continuea.*

SHIP LANTERNS AND LAMPS.
Upson-Walton Co.......... Cleveland.

SHIP TIMBER.
Martin-Barriss Co.........Cleveland.

SHOES.
Emerson Shoe Co. ......Cleveland.

SIGNALS—SUBMARINE.
Submarine Signal Co............Boston

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co..................................Jersey City, N. J.

STAYBOLT IRON OR STEEL BARS, HOLLOW OR SOLID.
Falls Hollow Staybolt Co.........................Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Holmes, Samuel ....New York.
McCarthy, T. R.....Montreal, Can.

STEAMSHIP LINES, PASS, AND FREIGHT.
American Line ....New York.
Boston Steamship ....Boston.
C. & B. Transit Co...........Cleveland.
International Mercantile Marine Co. .... Philadelphia.
Mallory Line ....New York.
New York & Cuba Mail S. S. Co.. ....New York.
Red Star Line ....New York.
Ward Line ....New York.

STEEL CASTINGS.
Otis Steel Co............Cleveland.

STEERING APPARATUS.
American Ship Building Co.......................Cleveland.
Chase Machine Co.......Cleveland.
Dake Engine Co...............................Grand Haven, Mich.
Detroit Ship Building Co....Detroit.
Hyde Windlass Co........Bath, Me.
Marine Mfg. & Supply Co.........................New York.
Sheriffs Mfg. Co........Wilwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J..........Boston.
Schrader's Son, Inc. A....New York.

SURVEYORS, MARINE.
Hynd, Alexander ....Cleveland.
Parker Bros. Co., Ltd......Detroit.
Nacey, James ....Cleveland.

SURVEYORS, MARINE—Continued.
Wood, W. J...............Chicago.

SYPHONS.
Philip Braender....New York City.

TESTS OF MATERIALS.
Hunt, Robert W. & Co....Chicago.
Lunkenheimer Co....Cincinnati, O.

THERMIT
Goldschmidt Thermit Co., ... New York City.

THREAD CUTTING TOOLS.
Armstrong Manufacturing Co. ....Bridgeport, Conn.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Watson-Stillman Co......New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc....Philadelphia.

TOWING MACHINES.
American Ship Windlass Co.........................Providence, R. I.
Chase Machine Co.......Cleveland.

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co.. ....Kingston, Ont.
Great Lakes Towing Co..Cleveland.

TRUCKS.
Boston & Lockport Block Co...... .... Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co..Pittsburg, Pa.

VALVES, STEAM SPECIALTIES, ETC.
Jenkins Bros. ....New York
Lunkenheimer Co........Cincinnati.
Ross Valve Co.........Troy, N. Y.

VALVES FOR WATER AND GAS.
Ashton Valve Co.,..........Boston.
Lunkenheimer Co........Cincinnati.
Ross Valve Co........Troy, N. Y.
Scoville Check Valve Co........... .... Ashtabula, O.

VESSEL AND FREIGHT AGENTS.
Billett, T. R...............Winnipeg.
Boland, John J.............Buffalo.
Douglas, G. L. Jr............Duluth
Elphicke, C. W. & Co......Chicago.
Hall, John B................Buffalo.
Helm & Co., D. T..........Duluth.

VESSELS AND FREIGHT AGENTS—Con.
Hawgood & Co., W. A....Cleveland.
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